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TRIGGERFISHES (BALISTIDAE) OF THE
EASTERN PACIFIC

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ABSTRACT: Six species of Balistidae occur in the eastern Pacific: *Balistes polylepis*, *Pseudobalistes naufragium*, *Sufflamen verres*, *Melichthys niger*, *Xanthichthys mento*, and *Canthidermis maculatus*. These are described and illustrated. The known ranges and general habitats are given for each. Keys are presented to facilitate identification of juveniles and adults. Relationships of these species with balistids from other areas are discussed.

The triggerfishes, family Balistidae, order Plectognathi, are cosmopolitan in warm seas throughout the world and are significant components of the marine environment. They are frequently very abundant in certain areas — occurring epipelagically as developing young, usually benthically or epibenthically as older juveniles and adults. Some of the species are voracious carnivores, others are largely omnivorous. The pelagic young are important as forage fish for predatory species, but the tough-skinned adults are not.

Human use of triggerfish is not great. No significant, selective, commercial fishery exists for them in North America; but they are fished for in some tropical areas, and are frequently caught incidental to other fishing operations. They are often taken in bottom trawls in shallow water and out to depths of 30 or 40 fathoms. They will strike at trolled or cast artificial lures, and take cut bait on hook and line. In some reef or rocky areas where they are abundant,

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they bite or strike bait so readily that they are considered a nuisance by fishermen who seek other species. Most triggerfish probably are scrappy fighters when hooked and give fast and hard action to a fisherman using light tackle. The species of *Balistes* that we have eaten have a very good flavor (*B. capriscus* and *B. polylepis*). The flesh of some species from tropical localities has been reported as toxic.

One major interest in the triggerfishes is the locking and trigger mechanism of the first two spines of the dorsal fin. This has been demonstrated by working models in museums and documented many times in technical and popular publications (see Clothier, 1939).

Several species of triggerfishes are held in high esteem by marine aquarists throughout the world because of their striking color patterns.

The major purpose of this paper is to afford convenient means to identify the juvenile and adult stages of eastern Pacific triggerfishes. Certain warranted changes in scientific names are documented. Protracted prejuvenile stages are described for *Melichthys niger* and *Sufflamen verres*. Sexual dimorphism in pigmentation is described for *Xanthichthys mento* and *Sufflamen verres*. For each species a synopsis is given on general external morphology, ontogenetic changes, distribution in the eastern Pacific, and relationship to extralimital species. Juveniles and adults of each species are illustrated.

Six species of Balistidae occur in the eastern Pacific. *Melichthys niger* and *Canthidermis maculatus* have world-wide distribution. *Xanthichthys mento* is distributed across the Pacific, and has close relatives in the western Indian Ocean and the western Atlantic. *Pseudobalistes naufragium* and *Sufflamen verres* are endemic to the eastern Pacific, but have near relatives in Hawaii and other Indo-Pacific waters. *Balistes polylepis*, currently thought to be an eastern Pacific endemic, is related to a western Atlantic species, but may have closer affinities with an Hawaiian form.

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METHODS

Methods of measuring and counting follow those used for Monacanthidae by Berry and Vogege (1961, p. 62, fig. 1) with the following additions:

Standard length (SL): All body lengths are given in millimeters of standard length.

Maximum depth: The greatest vertical measurement, usually through the end of the pelvic process; in specimens with the pelvic fan preserved in an expanded condition, the fan depressed before measuring.

Scale row counts: The number of rows, aligned obliquely dorsoventrally, from upper end of gill opening to end of caudal base; the counts not precise, due to a number of irregular oblique rows and intercalated rows on most specimens.

Pectoral fin rays: The spine at the dorsal origin of the fin not included in the count; this spine prominent in very small specimens, inconspicuous in large specimens; counts recorded from both fins of each fish, but without respect to right or left orientation. [In specimens with one more pectoral ray in one fin than the other, this bilateral variation appears to be random, neither right nor left.]

Gillraker counts: The total number on the lateral side of the first arch on the right side of the fish; arch exposed by an anterior incision from the lower margin of the gill slit; rakers close to the posterior end of the arch often difficult to count.

Vertebrae counts (abdominal + caudal, including the urostyle): The anteriormost caudal centrum defined as that centrum with the posterior margin of its hemal spine touching or in close apposition to the anterior margin of the dorsal portion of the first and enlarged interhemal spine (pterygiophore) of the anal fin. [The dorsal end of the first interhemal spine terminates below the junction of the eighth and ninth centra in two eastern Pacific species, *Melichthys radula* and *Canthidermis maculatus*, and nearly below the center of the eighth centrum in the other four species.]

Incasing scales of the pelvis: A term preferable to the previously used "pelvic spine" to denote the scales incasing the posterior end of the pelvis (see Tyler, 1962, p. 245).

Prejuvenile stage: The pelagic life-history stage of various marine fishes, characterized by morphological structure and appearance noticeably unlike that of the juvenile stage, and by rapid metamorphosis into the juvenile which is much more like the adult (see Hubbs, 1958, p. 282).

Abnormalities that were obvious in some specimens were not included in the general descriptions or tables. In the second dorsal and anal fins of some small specimens it was apparent, from the wide space between the bases of two consecutive rays, that a ray had not formed or had degenerated between these two. In some specimens with a low pectoral ray count on one side, as 15/12 or 13/10, abnormally multiple branching near the bases of several rays on the fin with the low count, suggested that two or more rays may have coalesced during an early stage of development.

Specimens of *Melichthys niger*, *Xanthichthys mento*, and *Canthidermis maculatus* from other than eastern Pacific localities were not used in the frequency distributions of tables 1 and 2.

The following collection abbreviation symbols are used here and in the text: AHF, Allan Hancock Foundation, University of Southern California; ANSP, Academy of Natural Sciences of Philadelphia; BC, Institute of Fisheries Research, University of British Columbia; BLLJ and BLSD, U. S. Bureau of Commercial Fisheries, Biological Laboratories at La Jolla and San Diego; BMNH, British Museum (Natural History); BPBM, Bernice P. Bishop Museum, Honolulu; CAS, California Academy of Sciences; LACM, Los Angeles County Museum; MCZ, Museum of Comparative Zoology, Harvard University; MNHN, Muséum National d'Histoire Naturelle; SIO, Scripps Institution of Oceanography; SU, Natural History Museum, Stanford University; TABL, U. S. Bureau of Commerical Fisheries, Tropical Atlantic Biological Laboratory, Miami; UCLA, University of California at Los Angeles; USNM, United States National Museum.

GENERIC SYNONYMY

We have classified the six species of eastern Pacific Balistidae into six genera. We can anticipate disagreement by some of our colleagues with these allocations, and we expect some taxonomists might label our decisions as "excessive splitting" into monotypic genera. Not one of these six genera is monotypic — each contains additional species in other areas of the world.

In the most creditable analysis yet published of generic relationships within the family Balistidae, Fraser-Brunner (1935, pp. 661–663) divided the family into 13 genera. This generic classification has variously been accepted, rejected, or ignored by subsequent authors; some have alternated in their application of Fraser-Brunner's opinions. Recently, de Beaufort (1962, pp. 278–281), dealing with species representing 11 genera by Fraser-Brunner's classifi-

TABLE 1. Frequency distributions of numbers of dorsal softrays, anal softrays, and pectoral rays (counted on both sides) for the six species of eastern Pacific Balistidae.

Species	Dorsal softrays											
	23	24	25	26	27	28	29	30	31	32	33	34
<i>Balistes polylepis</i>					3	18	19					
<i>Pseudobalistes naufragium</i>				3	27	5						
<i>Sufflamen verres</i>								5	19	14	2	
<i>Melichthys niger</i>									1	16	6	3
<i>Xanthichthys mento</i>							1	7	10	5	1	
<i>Canthidermis maculatus</i>	4	20	4									

Species	Anal softrays										
	20	21	22	23	24	25	26	27	28	29	30
<i>Balistes polylepis</i>						4	20	16			
<i>Pseudobalistes naufragium</i>					11	22	2				
<i>Sufflamen verres</i>								2	16	17	5
<i>Melichthys niger</i>								1	2	17	6
<i>Xanthichthys mento</i>							1	7	11	4	1
<i>Canthidermis maculatus</i>	3	17	7	1							

Species	Pectoral softrays									
	12-	12-	13-	13-	14-	14-	14-	15-	15-	16-
	12	13	13	14	14	15	15	16	16	16
<i>Balistes polylepis</i>				2	2	33	1			
<i>Pseudobalistes naufragium</i>			1	2	30	2				
<i>Sufflamen verres</i>					35	7	1			
<i>Melichthys niger</i>						1	17	1	1	
<i>Xanthichthys mento</i>	2	4	18							
<i>Canthidermis maculatus</i>			6	-	20	1				

cation, lumped all of them into the single genus *Balistes* — although he did recognize the 11 generic names in his key to the family and species, seemingly as subgenera.

We accept six of the genera proposed by Fraser-Brunner; we have not studied five others (*Abalistes*, *Balistoides*, *Odonus*, *Balistapus*, and *Rhinecanthus*); and we have reason to reject the other two (*Nematobalistes* and *Verrunculus*), which we consider to be junior synonyms of *Balistes*.

Nematobalistes Fraser-Brunner (monotypic, *B. forcipatus* Gmelin) was distinguished from *Balistes* by "First few rays of first [sic, = second] dorsal fin separate, filamentous. Anal fin not elevated anteriorly" (Fraser-Brunner, 1935, p. 659). The relatively great elongation of the first several rays of the second dorsal fin is an ontogenetic process in the late juvenile and adult stages, possibly

TABLE 2. Proportions (range in percentage of standard length) of body and fin parts in different length classes of six species of eastern Pacific Balistidae. [Ranges are rounded to the nearest one percent, except for eye diameter.]

Size (mm. SL)	<i>Balistes</i> <i>polylepis</i>	<i>Pseudo-</i> <i>balistes</i> <i>naufragium</i>	<i>Sufflamen</i> <i>verres</i>	<i>Melichthys</i> <i>niger</i>	<i>Xanthich-</i> <i>thys</i> <i>mento</i>	<i>Canthi-</i> <i>dermis</i> <i>maculatus</i>
Head length						
<50	39-40	35	35-38	39	41-47	37-39
50-99	36-39	43	35-38	34	34-39	35-36
100-199	34-36	37-39	37-38	30-32	32	33-34
200-299	34-36	37-40	35-37	29-30	29-30	32-33
300-399	33-34	38	33-35	29	-	-
>399	35	-	-	-	-	30-31
Snout length						
<50	21-23	22	21-23	27	23-26	17-20
50-99	22-24	25	23-25	22	21-24	19-20
100-199	24-25	26-28	28-29	20-21	20	19-21
200-299	25-26	28-30	28-29	20	18-20	18-19
300-399	25	29-30	27-29	19	-	-
>399	26	-	-	-	-	18-19
Eye diameter						
<50	11.8-12.7	8.0	9.6-11.8	9.4	13.2-14.7	12.1-12.3
50-99	9.3-10.5	12.5	8.9-10.8	6.8	8.0-11.0	8.3-9.7
100-199	7.2-8.6	7.7-9.7	6.5-8.3	6.3-7.5	7.2	7.3-8.6
200-299	6.4-7.8	6.9-8.1	5.3-6.4	5.0-5.7	5.5-5.6	6.0-6.9
300-399	5.3-5.4	5.6-6.6	4.1-4.7	3.9	-	-
>399	5.4	-	-	-	-	5.5-5.9
Depth, dorsal to anal						
<50	51-52	55	41-43	36	35-39	45-50
50-99	49-52	60	39-44	39	34	45-48
100-199	49-53	54-57	41-44	42-47	34	41-43
200-299	49-53	52-55	41-46	42-45	33-35	37-39
300-399	49-51	49-51	37-43	43	-	-
>399	53	-	-	-	-	36-37
Depth, maximum						
0-49	59-62	62	54-58	54	49-56	57
50-99	58-60	65	48-50	-	43-45	56
100-199	53-59	56-60	49-50	47-52	-	47
200-299	55-57	57-60	45-52	51	36-42	-
300-399	55-57	56-57	46-50	50	-	-
400+	58	-	-	-	-	37

associated with sexual dimorphism; and we do not believe this or the only moderately lobed anal fin are characters significant enough to warrant generic distinction.

TABLE 2. Continued.

Size (mm. SL)	<i>Balistes</i> <i>polylepis</i>	<i>Pseudo-</i> <i>balistes</i> <i>naufragium</i>	<i>Sufflamen</i> <i>verres</i>	<i>Melichthys</i> <i>niger</i>	<i>Xanthich-</i> <i>thys</i> <i>mento</i>	<i>Canthi-</i> <i>dermis</i> <i>maculatus</i>
Longest dorsal softray length						
<50	15-17	17	11	13	15-17	16-19
50-99	20-23	18	11-12	-	14-15	19-22
100-199	19-29	20-23	14-15	20-24	15	26-28
200-299	25-31	24-26	13-15	17-19	16-19	24-26
300-399	27-28	23-26	14-15	17	-	-
>399	27	-	-	-	-	23-27
Longest anal softray length						
<50	14-17	16	12-13	12	14-17	15
50-99	17-21	16	11-11	-	12-14	19
100-199	16-23	16-19	13	12-16	-	27
200-299	20-25	20-23	12	15-16	16-17	-
300-399	22	22-23	12-13	16	-	-
>399	26	-	-	-	-	22-24
First dorsal spine length						
<50	26-33	26	24-30	30	28-30	18-24
50-99	21-26	31	20-22	20	24-30	18-19
100-199	20-23	22-23	18-20	17-21	22	-
200-299	14-21	19-22	18-20	15-17	10-16	12-14
300-399	17	26	17-18	15	-	-
>399	15	-	-	-	-	10-12
Pectoral fin length						
<50	14-15	17	13-14	13	16-20	14
50-99	13-14	17	12-13	10	12-15	11-13
100-199	12-15	13-14	11-12	10-13	11	11-12
200-299	12-15	13-14	10-11	9-11	11-12	11-12
300-399	11	13-14	8-11	9	-	-
>399	13	-	-	-	-	11

Verrunculus Jordan (monotypic, *B. polylepis*) was distinguished from *Balistes* and *Nematobalistes* by "Scales on body much smaller than those on cheek" (Fraser-Brunner, 1935, p. 659). *Balistes polylepis* has a larger number of body scale rows than does *B. capriscus* Gmelin, and consequently on similar sized specimens the body scales on *B. polylepis* would be the smaller. Squamation on the cheek of *B. polylepis* is highly variable. On a few specimens the cheek scales are relatively large and somewhat symmetrically arranged, so that there appear to be several, narrow, longitudinal, and vertical grooves between the rows of scales; but on most specimens the cheek scales are relatively small and

are arranged irregularly, similar to those in *B. capriscus*; and in some specimens the sizes and arrangement are intermediate.

KEY TO ADULT EASTERN PACIFIC BALISTIDAE

- A. Five to eight conspicuous longitudinal grooves on cheek below eye B
- AA. Grooves on cheek absent or inconspicuous C
- B. Body scales separated; dark pigment between scales. Figure 13 .. *Xanthichthys mento*
- BB. Body scales close together; no dark pigment between scales. Figure 8 *Sufflamen verres*
- C. Small scales posterior to gill opening, of similar size to other body scales. Figure 16 *Canthidermis maculatus*
- CC. Enlarged scales posterior to gill opening, much larger than adjoining body scales D
- D. Scaleless area on snout behind jaws. Figures 3B and 5 .. *Pseudobalistes naufragium*
- DD. Snout completely scaled E
- E. No longitudinal ridges on posterior part of body. Figure 4 .. *Balistes polylepis*
- EE. Eight to ten longitudinal ridges on posterior part of body. Figure 11 .. *Melichthys niger*

KEY TO YOUNG EASTERN PACIFIC BALISTIDAE

(smaller than 100 mm. SL)

- 1. Dorsal rays 23 or 24 *Canthidermis maculatus*
- 2. Dorsal rays 25
 - a. Body depth (dorsal to anal) 45–50 percent SL, 2.0–2.2 into SL *C. maculatus*
 - b. Body depth (dorsal to anal) 55–60 percent SL, 1.7–1.8 into SL *Pseudobalistes naufragium*
- 3. Dorsal rays 26–27
 - a. Snout completely scaled. Dorsal rays modally 27 (table 1) *Balistes polylepis*
 - b. Snout scaleless posterior to lips (at least as small as 34 mm. SL, possibly not scaleless in smaller specimens). Dorsal rays modally 26 (table 1) *P. naufragium*
- 4. Dorsal rays 28–29
 - a. Body depth (dorsal to anal) 49–52 percent SL, 1.8–2.1 into SL *B. polylepis*
 - b. Body depth (dorsal to anal) 34–39 percent SL, 2.6–2.9 into SL .. *Xanthichthys mento*
- 5. Dorsal rays 30–34
 - a. Pectoral rays 12/12 to 13/13 *X. mento*
 - b. Pectoral rays 14/14 to 16/16
 - i. Pectoral rays modally 15. Snout profile blunter (see fig. 9) .. *Melichthys niger*
 - ii. Pectoral rays modally 14. Snout profile less blunt (see figs. 6 and 7) *Sufflamen verres*

Balistes polylepis Steindachner.

Finescale Triggerfish.

(Figures 1A, 2A, 3A, 4.)

Balistes polylepis STEINDACHNER, 1876, p. 69 (type locality, Magdalena Bay, Baja California, Mexico).

Body moderately deep; caudal peduncle laterally compressed; head profile usually slightly convex, occasionally flat or with only a slight convexity over snout.

Scales covering entire body and head (fig. 3A); scales generally of similar size; some slightly smaller scales on head. Most specimens with scales in irreg-

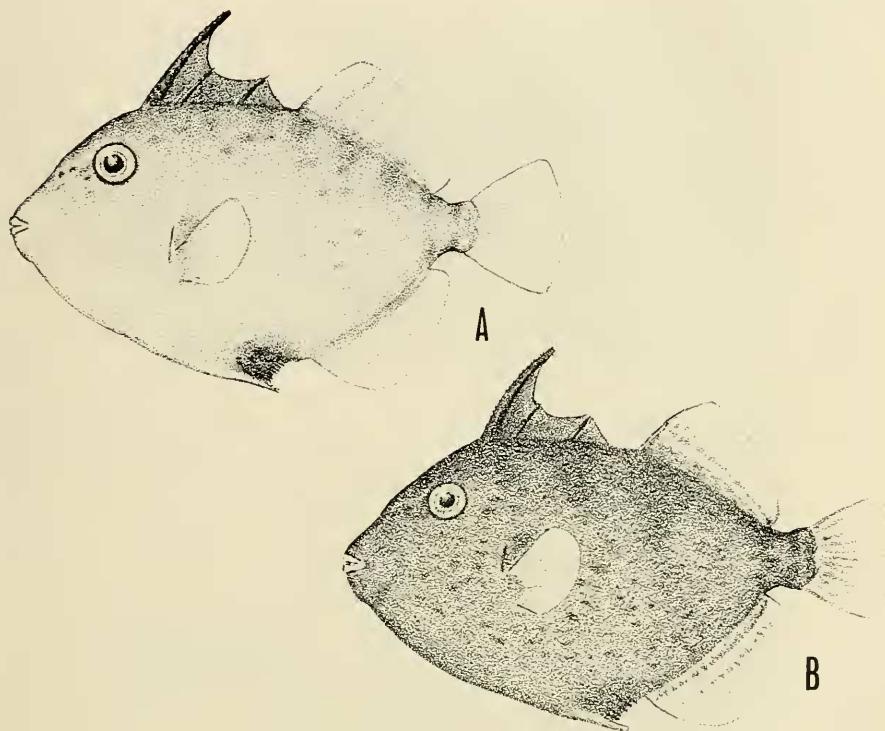


FIGURE 1. A, *Balistes polylepis*, 38.4 mm. SL, Magdalena Bay, Baja California, Mexico, SIO 60-294. B, *Pseudobalistes nanfragium*, 34.4 mm. SL, Banderas Bay, Jalisco, Mexico, BLLJ station B6108-31.

ular arrangement below eye; a few specimens with these scales aligned to form 4 or 5 short, narrow, horizontal and inconspicuous grooves between the scale rows. No ridges on posterior part of body. Enlarged scales (4 or 5) posterior to gill opening. Incasing scales of pelvis forming a movable process. Preorbital groove pronounced.

Teeth with moderately strong cusps, the cusps becoming progressively smoother with growth (cusps worn off median pair of lower jaw teeth at sizes larger than about 150 mm. SL).

D. III, 26-28; A. 24-26; P_1 13-15 (table 1). Third dorsal fin spine not markedly shortened. Soft dorsal fin with a pronounced anterior lobe developing at about 50 to 70 mm. SL. Anal fin with anterior rays longer, but not forming as pronounced a lobe as in soft dorsal fin. Caudal fin rounded to about 70-80 mm. SL, becoming emarginate at larger sizes, and falcate at about 120-150 mm. through progressive elongation of the most dorsal and the most ventral

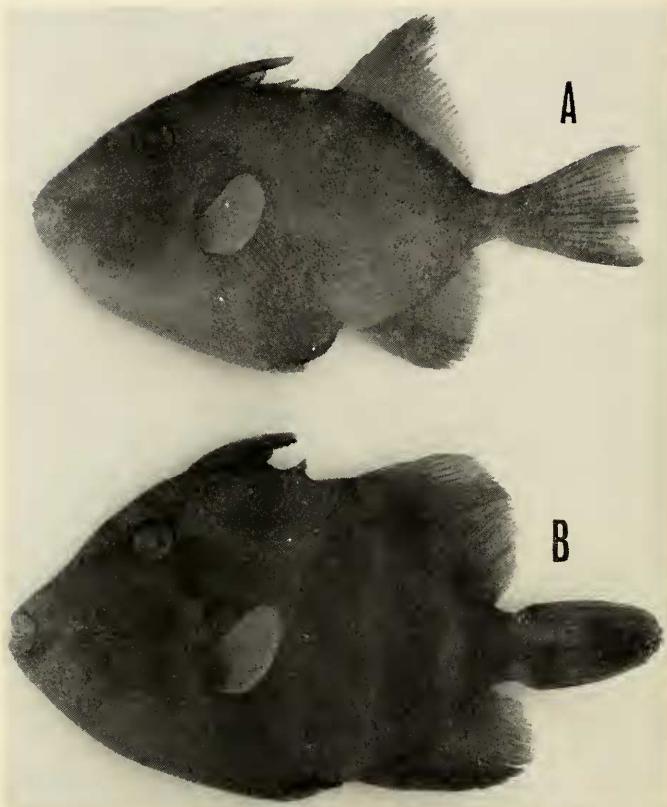


FIGURE 2. A, *Balistes polylepis*, 96.5 mm. SL, Bahia de los Angeles, Baja California, Mexico, SIO 62-236. B, *Pseudobalistes naufragium*, 100.5 mm. SL, Bocochibampo Bay, Sonora, Mexico, UCLA W51-3.

caudal rays. Scale rows 58–62 (8 specimens). Gillrakers 29–37 (12). Vertebrae 7 + 11 (4).

PIGMENTATION. Late juveniles and adults (figs. 2A and 4) generally dark, but lighter on ventral half of head and body; fins dusky with pectorals the clearest; fringed area behind pelvic process darker than other ventral parts of body on some specimens. Juvenile pigmentation persistent to about 100 mm. SL or smaller as large spots below third dorsal spine, soft dorsal origin, and soft dorsal termination. Small pelagic juveniles (fig. 1A) slightly darker on upper part of body, with a characteristic black or very dark dorsal spine membrane and a black area behind the incasing scales of the pelvis; usually four dark areas or spots along the dorsal fin base and three along the anal base, and

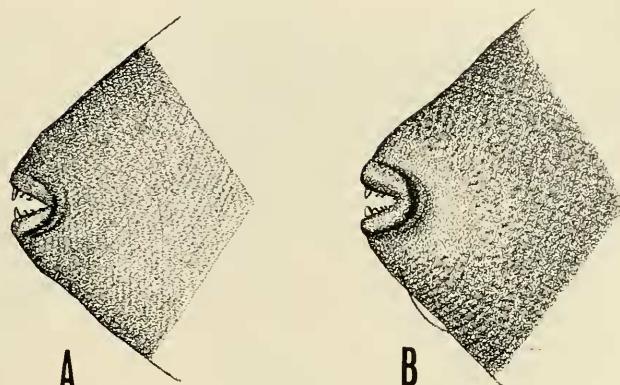


FIGURE 3. Squamation of snout. A, *Balistes polylepis*, 117 mm. SL, UCLA W54-366. B, *Pseudobalistes naufragium*, 115 mm. SL, UCLA W51-3.

irregular spots scattered over the body; the softrayed fins usually clear, but scattered pigment occurring in fins of some individuals.

RANGE. This endemic eastern Pacific species has been reported from Lobos de Afuera, Peru (Hildebrand, 1946, p. 481) to San Francisco, California (Radovich, 1961, p. 30). We have examined specimens from Colombia to northern California and from the offshore islands of Malpelo, Galápagos (Charles), Revillagigedo (Socorro), and Tres Marias (Cleopha) — (fig. 17). This species occurs in offshore waters and at oceanic islands but not so frequently as *S. verres*, and it does not have the more oceanic orientation of *Melichthys*, *Xanthichthys*, and *Canthidermis*. The furthest offshore collection, about 110 miles southwest of Panama, consisted of four young, 47.5–108 mm. SL, taken under floating bamboo in a tide rip.

A single specimen, 254 mm. SL, from NW. of Crescent City, California, represents the northernmost record of the species and the family in the eastern Pacific. The specimen (SIO 60-511), taken off St. George Light, $41^{\circ}50'N.$, $124^{\circ}22'W.$, in water 280 fathoms deep, 20 October 1960, by the trawler "City of Eureka," was given to the Scripps Institution of Oceanography fish collection by the Marine Resources Division of the California Department of Fish and Game on 10 January 1961 (R. H. Rosenblatt, personal communication). We do not know the depth at which the trawl caught this specimen. This record is not shown in fig. 17.

RELATIONSHIPS. Three specimens, 251, 262, and 360 mm. SL, labeled *Balistes fuscus* from Honolulu, Hawaii (ANSP 93826, and BPBM 5013), and the illustration based on another Hawaiian specimen labeled *B. fuscus* by Fowler (1928, pl. XLV, fig. C) are referable to *B. polylepis*. They are not

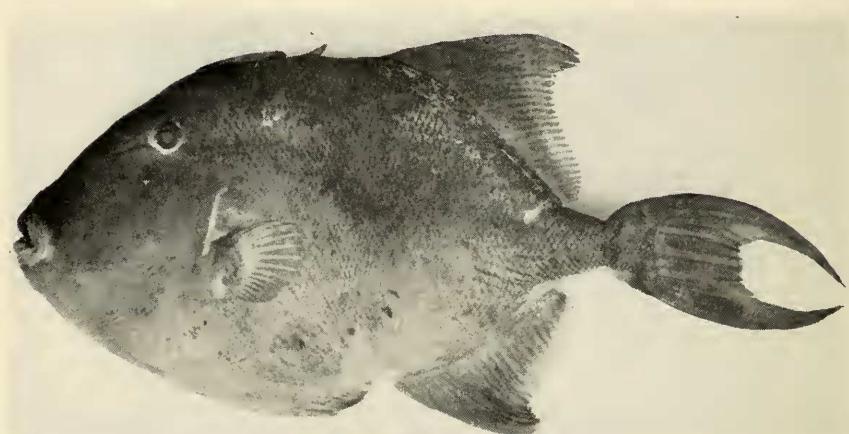


FIGURE 4. *Balistes polylepis*, 442 mm. SL, Marquis Point, Baja California, Mexico, SIO 62-703.

Balistes [= *Pseudobalistes*] *fuscus* Bloch and Schneider 1801, which has a scaleless area on the snout and a relatively shallow preorbital groove. The Hawaiian specimens cannot be identified through the use of two publications on Hawaiian Balistidae (Jordan and Evermann, 1905, pp. 407-418; Clark, 1949, pp. 9, 10), and, although they key out to *B. fuscus* in another (Gosline and Brock, 1960, p. 292), this last treatment is not specific. This species in Hawaiian waters is generally inadequately known or unrecognized. It may also occur in other Indo-Pacific areas, and these uncertainties restrict our analysis of the zoogeography and relationships of the species of *Balistes*.

Balistes polylepis appears to be a "distant" geminate of *B. capriscus* Gmelin of the Atlantic. *Balistes polylepis* tends to have more scale rows and lacks the punctulated stripes on the second dorsal and anal fins of *B. capriscus*. In most specimens of *B. polylepis* the cheek scales are smaller and more irregularly arranged than in *B. capriscus*; but this character varies among individuals in *B. polylepis*, and the cheek scales of a few specimens of *B. polylepis* we have seen are almost identical to those of *B. capriscus*.

Pseudobalistes naufragium (Jordan and Starks).

Smoothcheek Triggerfish, Pez Puerco de Piedra.
(Figures 1B, 2B, 3B, 5.)

Balistes naufragium JORDAN and STARKS in Jordan, Starks, Culver, and Williams, 1895, p. 488 (type locality, Mazatlan, Mexico; holotype 173 mm. SL, SU 1656).

Body moderately deep; caudal peduncle compressed; head profile straight or slightly convex over eye and slightly concave over snout.

Scales normal over most of body; an area around snout becoming scaleless (possibly by absorption or sloughing of scales) — (fig. 3B); extent of scaleless area increasing with growth of fish, about anterior 30 percent of head at 51 mm. SL, about 40 percent at 121 mm., and about 60 percent at 322 mm. Scales on posterior part of head slightly smaller than those on body. Scales in area below eye aligned in indistinct and irregular horizontal or slightly oblique rows (less distinct on larger specimens). No ridges on posterior part of body. Enlarged scales (4) posterior to gill slit. Incasing scales of pelvis forming a movable process. Preorbital groove very shallow and short, scarcely evident.

Teeth with moderately strong cusps; worn off median pair of lower jaw teeth in larger specimens, and these two teeth rounded.

D. III, 25-27; A. 23-25; P₁ 13-15 (table 1). Third dorsal fin spine not markedly shortened. Soft dorsal fin with anterior rays forming a slight lobe by about 200 mm. SL, causing the fin to slant downward to the rounded posterior margin. Anal fin rounded with the anterior rays longer, but not forming an anterior lobe, and becoming angulate (sloping backward) in larger specimens. Caudal fin rounded to about 135 mm. SL, becoming biconcave with slightly elongated dorsal and anal lobes at larger sizes. Scale rows about 45-55 (6 specimens). Gillrakers 31-36 (6). Vertebrae 7 + 11 (6).

PIGMENTATION. Juvenile, 34.4 mm. SL (BLLJ station B6108-31, figure 1B): traces of five body bars, mainly on dorsal part of body; spots scattered over generally dark-pigmented body; dusky row of spots along base and just distal to base of both soft dorsal and anal fins; spinous dorsal fin dark; caudal dusky; pectorals clear. Juvenile, 51 mm. SL (BC 59-674): specimen somewhat faded; six body bars, first two under spinous dorsal and extending only about halfway down side, third under origin of soft dorsal fin, fourth under middle and fifth under termination of fin, sixth on posterior end of caudal peduncle; trace of one narrow band across interorbital area; no scattered spots on body or fins; fins clear except for dusky membranes of the spinous dorsal fin. Juveniles 101-121 mm. SL (6 specimens, UCLA W51-3, fig. 2B): five body bars (the anterior two noted on the 51-mm. specimen apparently fused into one on these and other larger specimens), the first bar interrupted but extending nearly to ventral profile, the other four bars extending to ventral profile; small spots scattered over dorsal half of body; two bands across interorbital area; a short line posterodorsal to eye and a broader line posteroventral to eye extending to first body bar, these lines fused into a solid blotch on some specimens; a small dark fringed area behind pelvic process; spinous dorsal fin dark; pectoral fin nearly clear; the other three fins dusky; scattered spots on posterior parts of soft dorsal and anal fins on one 115-mm. specimen. Other larger specimens examined have these body bars, the fifth bar tending to become obscure. The largest specimen with body bars was 211 mm. (UCLA

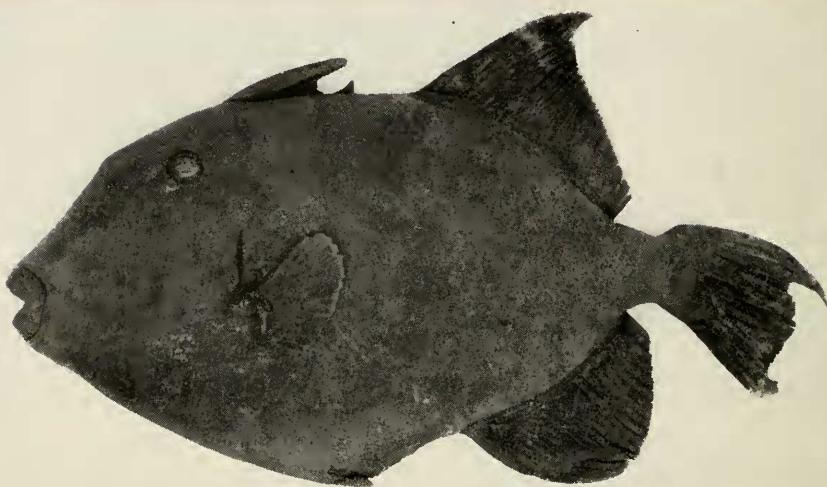


FIGURE 5. A, *Pseudobalistes naufragium*, 352 mm. SL, Islas Venados, Sinaloa, Mexico, UCLA W51-43.

W56-115), and only the anterior four bars were visible; this specimen was the only one seen that had three bands across the interorbital area (a 203-mm. specimen from the same station had the usual two bands). One collection of three specimens, 118, 164, and 178 mm. SL, from Panama (SU 6877), afforded the suggestion of variation in pigmentation: all have traces of the interorbital bands; the 118- and 164-mm. specimens have five faint body bars; the 178-mm. specimen lacks the bars, and has a mottled pattern of many thin, irregular and wavy, variously directed, dark lines—this last is reminiscent of the lines shown for a specimen of about 135 mm. of *Pseudobalistes fuscus* from the Red Sea by Clark and Gohar (1953, text-fig. 5c). A larger specimen (237 mm., UCLA W56-114) and the two largest specimens examined, 322 mm. (SIO 62-63) and 352 mm. (UCLA W51-43, fig. 5), have no distinctive markings but have generally dark pigment all over with lighter pigment distally on the dorsal and anal softrays.

RANGE. This endemic eastern Pacific triggerfish is apparently common nowhere. It is known to range from Guayaquil, Ecuador (SU 9305, CAS IU13432a, USNM 53485), to Santa Maria Bay on the western coast of Baja California (UCLA W55-100), and to Bocochibampo Bay, Sonora, on the mainland coast of Mexico (UCLA W51-3). It has not been recorded from the major offshore islands, but has been taken at Isabel Island off Nayarit, Mexico (SIO 62-63). Specimens that Fowler (1944, pp. 298, 412, 526) recorded from "North

of Galápagos" and from Isabel Island as *Balistes naufragium* are not this species, but are young of *Balistes polylepis*.

RELATIONSHIPS. Four nominal species were assigned to the genus *Pseudobalistes*, characterized by a scaleless area on the cheeks and a shallow preorbital groove, by Fraser-Brunner (1935, p. 663). De Beaufort (1962, pp. 305–306) recognized two of these species as valid, *P. fuscus* (Bloch and Schneider) and *P. flavimarginatus* (Rüppell), both ranging from eastern Africa eastward to the Tuamotu Islands; *P. fuscus* ranging northeastward to Hawaii. De Beaufort considered the third species, *P. chrysospilos* (Bleeker), to be a junior synonym of *P. fuscus*. The fourth nominal species listed by Fraser-Brunner, *P. naufragium*, one of three valid species of *Pseudobalistes*, is most closely related to *P. fuscus*, which was briefly defined and finely illustrated from Red Sea specimens by Clark and Gohar (1953, p. 28, text-figs. 5a, 5b, and 5c; pl. I, fig. 1). *Pseudobalistes naufragium* and *P. fuscus* have similar numbers of fin rays, but differ appreciably in the pigmentation pattern of their juvenile stages.

Sufflamen verres (Gilbert and Starks).

Carr's Triggerfish, Coche.

(Figures 6, 7, 8.)

Balistes verres GILBERT and STARKS, 1904, p. 153, pl. XXVI, fig. 49 (type locality, Panama; holotype SU 6805).

Body moderately elongate and shallow; caudal peduncle compressed; snout and head profile generally straight, sometimes slightly concave anterior to front of eye and convex above eye.

Scales covering entire head and body. Seven or eight horizontal grooves below eye, irregular and pronounced, but shallow; enlarged scales in single rows between the grooves; scales anterior and posterior to this area slightly smaller than scales on remainder of body. Area on sides from about a vertical at soft dorsal fin origin to caudal base with about 10 to 14 horizontal, interrupted ridges formed by elevated processes on anterior angle of scales. Enlarged scales (3 or 4) behind gill slit. Incasing scales of pelvis movable. Preorbital groove moderately deep and pronounced.

Teeth with moderate to strong cusps, the cusps usually worn almost smooth on medial teeth of large specimens, especially in lower jaw.

D. III, 30–33; A. 27–30; P₁ 14–15 (table 1). First dorsal spine thick; third spine short, but not markedly reduced. Soft dorsal and anal fins without pronounced fin lobes, fourth or fifth rays the longest. Caudal fin truncate to about 180 mm. SL, becoming emarginate at larger sizes with the most dorsal and ventral rays slightly produced. Scale rows 52–57 (3 specimens). Gillrakers 27–31 (4). Vertebrae 7 + 11 (3).

ONTOGENY AND PIGMENTATION. *Sufflamen verres* exhibits sexual dimorphism in pigmentation and has a characteristic spotted prejuvenile stage.

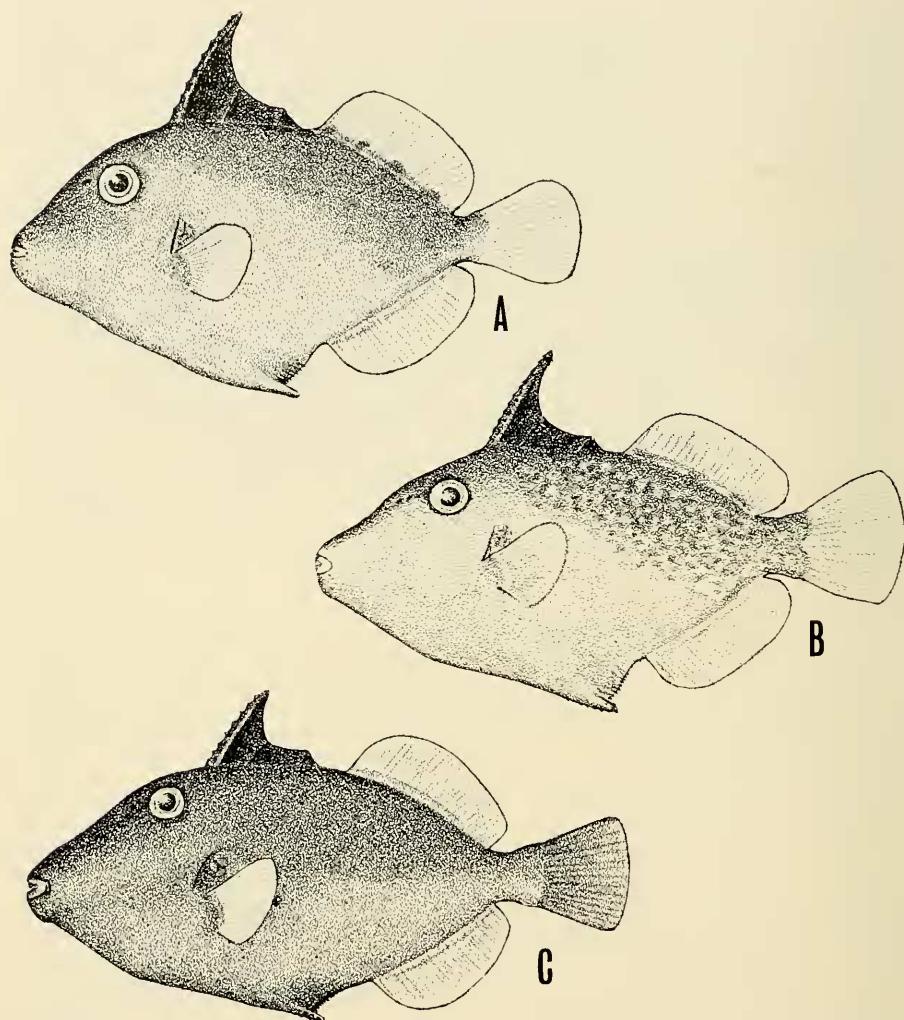


FIGURE 6. *Sufflamen verres*. A, 26.0 mm. SL, 69 miles off Acajutla, El Salvador, UCLA W58-222. B, 46.5 mm. SL, Clipperton Island, UCLA W56-161. C, 54.6 mm. SL, Ceralbo Island, Gulf of California, Mexico, UCLA W61-34.

In the smallest juveniles examined, 12.6 mm. (UCLA W60-139) to 26 mm. SL, the body is dark on the upper part and light on the lower, with three or four spots developing along the base of the dorsal fin (fig. 6A). Spots begin to develop on the upper part of the body at about 26 mm., and this "late" or spotted prejuvenile stage probably persists to an average length of about 55 mm. (as in fig. 6B). It may extend in a "protracted" prejuvenile stage, to at

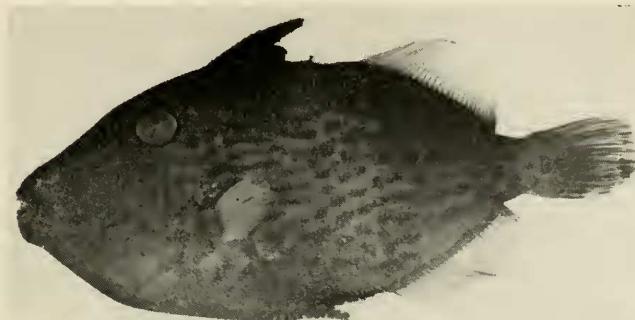


FIGURE 7. *Sufflamen verres*, 64 mm. SL, Clipperton Island, SIO 62-341.

least 75.5 mm. (BC 60-464, as in fig. 7), or transformation to the unspotted juvenile stage may occur in specimens as small as 50.5 mm. (UCLA W61-34, as in fig. 6C). In the protracted prejuvenile stage, the spots tend to elongate into an irregular series of broken lines (fig. 7); in the largest specimen of this stage, the broken stripes are restricted to an area just above each pectoral fin, and are visible only when the specimen is wet.

In some of the smaller juvenile specimens, the body is almost uniformly dark brown. In others, the lower part of the body is lighter (fig. 6C).

The pigmentation of males and females is similar in pattern but is very different in intensity. In males the dark upper body parts are darker and the lower body parts much lighter than in females (fig. 8). In males the throat is very light and the lower half of the body from the peduncle to near the pelvic fins is only slightly darker. The line on each side from the posterior angle of the lips to below the gill slit, and the band extending under the throat and connecting these two lines, are very pronounced in males, but are generally vague or not apparent in females. The pronounced pigmentation pattern was present in 17 males, 197–375 mm., and the pale pigmentation in 30 females, 141–342 mm. The sex of these 47 specimens was determined by gross examination of the gonads. In an additional 27 specimens, 100–204 mm., we either could not locate gonads or could not determine sex.

The liver was extremely large, almost filling the body cavity, in two specimens of the protracted prejuvenile stage, 62 and 65 mm. (CAS 6036). In juvenile specimens of similar lengths and in many adults examined, the liver was relatively much smaller.

RELATIONSHIPS. *Sufflamen verres* is closely related to *S. fraenatus* (Latreille) [= *S. capistratus* (Shaw) = *S. mitis* (Bennett)] which ranges from Hawaii westward to South Africa. The two species are very closely similar in morphology and in adult pigmentation. Specimens of *S. fraenatus* from the

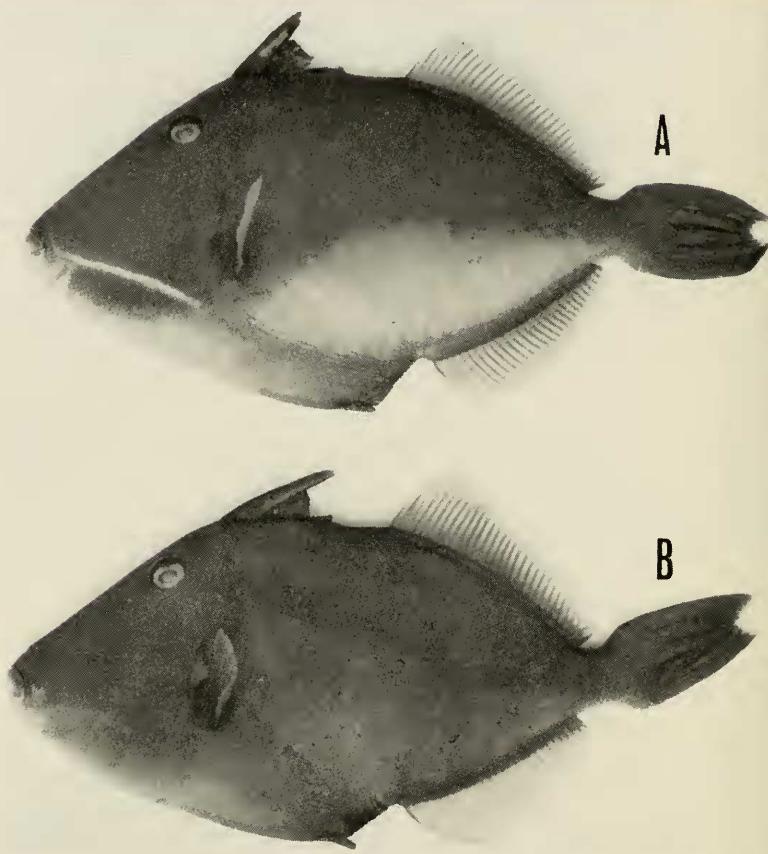


FIGURE 8. *Sufflamen verres*. A, male, 206 mm. SL. B, female, 210 mm. SL. Punta los Custodios, Nayarit, Mexico, UCLA W58-37.

central Pacific have a lower number of softrays (about D. 28–30, A. 24–26) than *S. verres* (table 1); but a specimen of *S. fraenatus* (ANSP 101164) from South Africa, at the western extreme of the range, has D. 31 and A. 27, very similar to *S. verres*.

RANGE. This endemic eastern Pacific species is known to range along the American continent from Salinas, Ecuador (Orces, 1959, p. 89), to near Cedros Island, western Baja California, Mexico (SU 57245). It occurs at most of the offshore islands—the Galápagos, Cocos, Clipperton, Revillagigedos, and Tres Marias Islands—and has been taken well offshore as developing young. The northernmost record for the species, near Cedros Island, is based on a

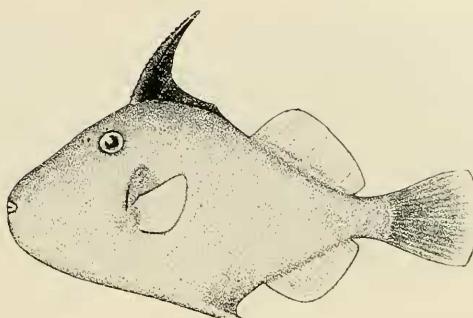


FIGURE 9. *Melichthys niger*, 47.4 mm. SL, Clarion Island, UCLA W55-163.

30.5-mm. SL prejuvenile, collected November, 1937 by the ZACA, and labeled as "food of *Makaira mitsukutii*."

***Melichthys niger* (Bloch).**

Black Triggerfish, Black Durgon, Galafate.
(Figures 9, 10, 11.)

Balistes nigra OSBECK, 1757, p. 295 (species name pre-Linnean and not available; type locality "Assensionen").

Balistes niger BLOCH, 1786, p. 27, pl. CLII, fig. 2; plate incorrectly labeled *Balistes ringens*; type locality, "? chinesischen Gewässer").

LE BALISTE SILLONNÉ Lacépède, 1798, p. 370, pl. 18, fig. 1 (vernacular name only; type locality "Mers des Indes"; cited as *Balistes sillone* Lacépède with holotype A. 8497 in Muséum National d'Histoire Naturelle according to Le Danois, 1961, p. 519).

Balistes radula SOLANDER in Richardson, 1848, p. 21, pl. 6, figs. 1-4 (type locality, Pacific Ocean?).

Balistes kibitar THIOLLIÈRE, 1857, p. 216 (type locality, Woodlark Island; according to Fowler, 1928, p. 455).

Balistes piceus POEY, 1863, p. 180 (type locality "Havane").

Melichthys bispinosus GILBERT, 1890, p. 125 (type localities, Clarion and Socorro Islands).

Balistes fuscelineatus SEALE, 1901, p. 9, fig. 4 (type locality, Honolulu; holotype no. 664 and paratype in Bernice P. Bishop Museum according to Fowler, 1928, p. 455).

Body moderately elongate; caudal peduncle compressed; head profile concave above eye, slightly convex above snout on some specimens.

Scales covering entire head and body; no grooves between scale rows below eye; scales on body posterior to soft dorsal fin origin with keels forming 8 to 10 longitudinal ridges. Enlarged scales (4 or 5) behind gill opening. Incasing scales of pelvis movable, tending to become fixed in large specimens. Preorbital groove moderately deep and pronounced.

Teeth with cusps in young specimens becoming truncate with growth, especially on the medial teeth (see below).

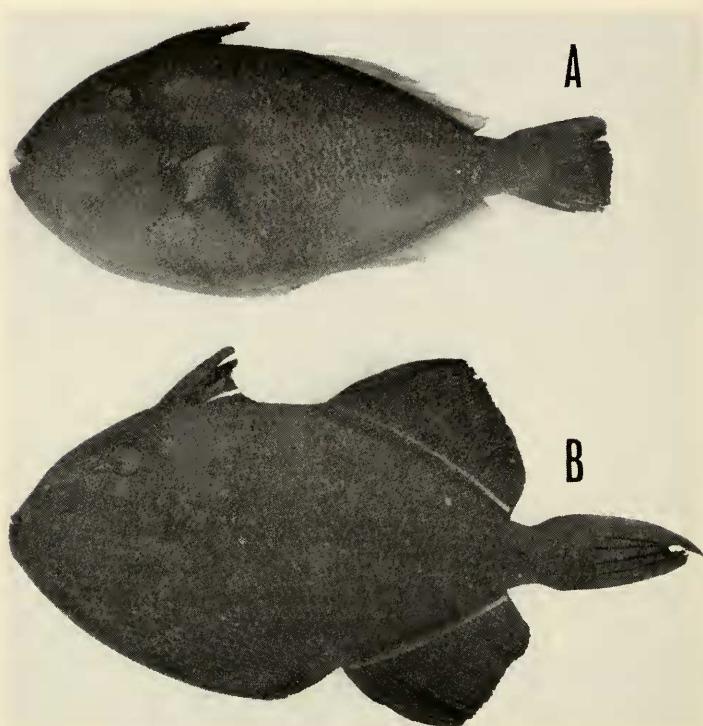


FIGURE 10. *Melichthys niger*. A, prejuvenile, 121 mm. SL, Cocos Island, UCLA W55-52. B, juvenile, 125 mm. SL, Clipperton Island, UCLA W56-236.

D. III, 31-34; A. 27-30; P₁ 14-16 (table 1). Third dorsal spine small, very small and recessed below the dorsal profile at sizes larger than about 130 mm. SL. Soft dorsal and anal fins with the anterior rays longest, but without a pronounced lobe. Caudal fin biconcave at about 128 mm. Scale rows 52-54 (3 specimens). Gillrakers 33-39 (3 specimens). Vertebrae 7 + 11 (4 specimens), 7 + 12 (in one apparently normal specimen, UCLA W53-126).

ONTOGENY AND PIGMENTATION. The eastern Pacific specimens examined represent four growth stages that differ in morphology and pigmentation:

Early prejuvenile (1) 47.4 mm. SL (UCLA W55-163).

Late prejuvenile (4) 91, 121, 128, 144 mm. (SIO 62-341; UCLA W55-52, W51-266; BC 57-143).

Transforming prejuvenile (1) 127 mm. (BC 56-329).

Juvenile and Adult (42) 90, 96.5, 97, 99, 107, 108, 108, 113, 118, 119, 124, 126, 126, 159 mm., and 28 larger specimens.

The early prejuvenile specimen (fig. 9) differs in body shape and in having less pronounced pigmentation than the late prejuveniles.

The late prejuvenile specimens (fig. 10A) are dark on the upper part of the body and lighter below and have clear dorsal and anal fins and six or seven narrow dark orbital bands radiating from the eye (the 4 median bands usually join across the top of the head). Single specimens, similar to these, with clear fins, light bodies, eye bands, and cusped teeth have been examined from Hawaii (ANSP 88511), the Tuamotu Islands (CAS uncataloged), and Aves Island west of Dominica in the Caribbean Sea (TABL, OREGON station 4987).

In the characteristic black juvenile and adult stages, the body and fins are entirely black except for areas of the dorsal, anal, and caudal fins (fig. 11). A narrow white stripe (sometimes described as blue) extends along the base of both the dorsal and anal fins. The caudal fin is progressively lighter from the caudal base posteriorly to a dark lunate bar that extends from the dorsal to the ventral lobe; this bar has a narrow, pale posterior margin followed by a broader and slightly darker area at the distal edge of the fin. A series of nine specimens from a collection from Cocos Island (BC 56-329) contains the single transforming prejuvenile (127 mm.) and eight dark juveniles (90–126 mm.). The four smallest of these (90–97 mm.) have visible orbital bands, and the black pigmentation is not so intense as in the larger prejuveniles (107–126 mm.). The orbital bands are apparent in juveniles up to 118 mm., but are very indistinct in slightly larger specimens, and are not visible in most specimens larger than 126 mm. They apparently are only obscured by the black body pigmentation, for in a very old and very faded specimen of 247 mm., eight orbital bands are apparent (USNM 5988).

In the transforming prejuvenile specimen the body is uniformly brownish, the dorsal and anal fins are less brownish, and the narrow, clear basal area in both fins (that will become the white stripe in the juvenile) is apparent; the orbital bands are detectable but vague.

The color in life of a prejuvenile specimen was given by Seale (1901, p. 9, fig. 4), under the name of *Balistes fuscolineatus*. Color of the adults in life was excellently described by Randall (1955, p. 220), under the name of *Melichthys buniva*, and notes on live coloration were given by Jenkins (1903, p. 483).

The genus *Melichthys* has been characterized as having teeth lacking cusps or points. Tooth structure changes are associated with transformation from the prejuvenile to the juvenile stage. The prejuveniles have pronounced cusps on all teeth, but these are generally more rounded in the larger prejuveniles. The smaller juveniles (90–126 mm.) generally show a progression of rounding of the cusps with increase in size; the median pair of teeth in the upper jaw become truncate. Teeth in the lateral parts of the jaws never become entirely truncate, but retain evidence of the prejuvenile cusps. The smallest juvenile observed with truncate teeth was 113 mm. The largest juvenile with pro-

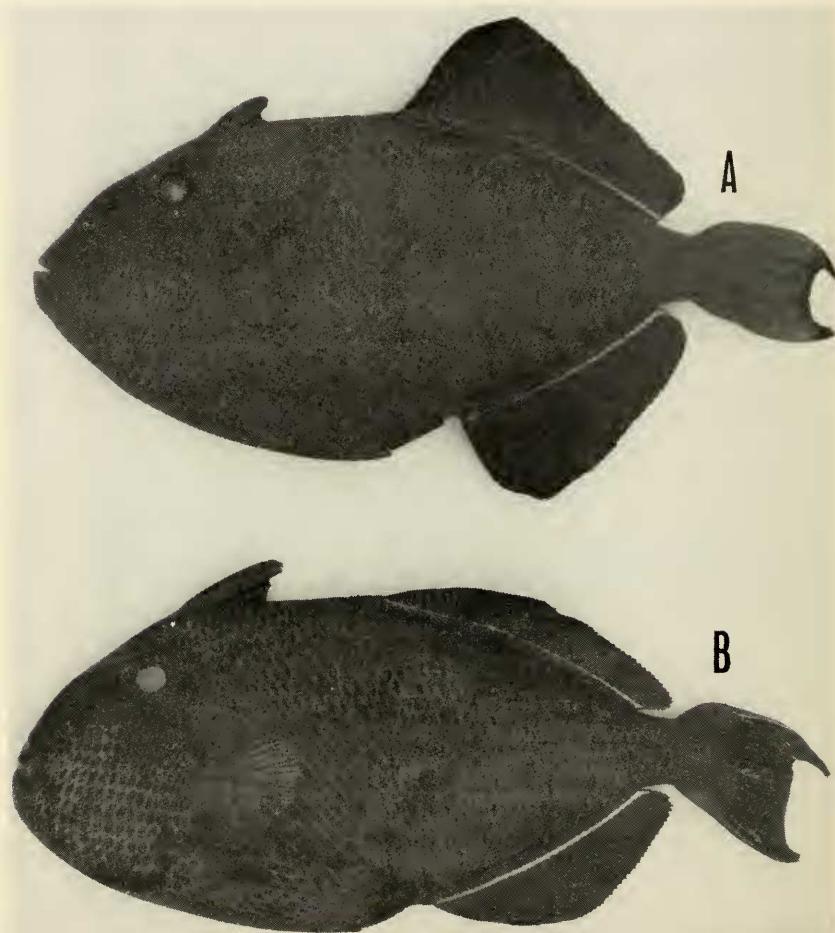


FIGURE 11. *Melichthys niger*. A, female, 206 mm. SL. B, male, 203 mm. SL. Cocos Island, SIO 59-334.

nounced, unrounded tooth cusps was 108 mm. The change in tooth shape probably represents a change in habitat and feeding habits.

The head profile of adults is variable. Most have a slight notch under the lower jaw, as does the female in fig. 11A. The male in fig. 11B has a blunt, rounded snout, but this may not indicate sexual dimorphism, for several other males have the same head shape as the female in fig. 11A. The size ranges of specimens for which we were able to determine sex were: males, 183–306 mm., and females, 192–230 mm.

The liver was relatively much larger in seven late prejuvenile specimens

than in several juveniles and adults. A similar situation was observed in *S. verres*. We have not examined this feature in detail, but it suggests some interesting problems of physiology.

RANGE. A circumtropical oceanic species, usually associated with oceanic islands. In the eastern Pacific known only from Malpelo, Cocos, and Clipper-ton Islands and from Clarion and Socorro Islands in the Revillagigedo Islands. We have examined specimens from each of these localities (fig. 18). A specimen was reported from between Cocos Island and Panama, at 7°00'N., 84°10'W., by Clemens (1955, p. 166), but we have been unable to locate it to verify the identification. Rosenblatt and Walker (1963, p. 102) indicated that *Melichthys* had been collected on the mainland of western America, but we have not located or confirmed the record. There is a suggestion that this species may have occurred on the mainland. Girard (1858, p. 338) mentioned specimens of balistids collected at San Diego, California, by A. Cassidy that "were of a jet black tint, with light (either white or yellow) margined fins"—these specimens were lost prior to 1858 in moving a large collection of fishes to the Smithsonian Institution. Although we consider it unlikely, it is possible that these lost specimens mentioned by Girard could have been *M. niger*, for oceanic conditions off San Diego in the 1850's were different from those of recent decades (see Hubbs 1949, p. 464).

We have not thoroughly investigated details of the world-wide distribution of *M. niger*. The range was recorded by de Beaufort (1962, p. 284) as, "Sumatra (Priaman); Menado?—Durban, Delagoa Bay, Zanzibar, Seychelles, Mauritius, Ceylon, Christmas Island, China, Philippines, Pacific eastwards as far as Cocos Island, tropical Atlantic." De Beaufort further stated that the only specimen known with certainty from the Indo-Australian Archipelago was that from Priaman, Sumatra, recorded by Bleeker; however, we can confirm as *M. niger* the description of a prejuvenile specimen (under the name of "? *Melichthys buniva*") from Menado, Celebes, by Koumans (1953, p. 262). Fowler (1928, p. 455) reported specimens from a number of central Pacific localities—Thorton Island, Tuamotus, Johnson Island, Marshall Islands, Honolulu, Hawaii, Marcus Island, French Frigates Shoal, Gardner Island, Necker Island, Wake Island, and Lysan Island.

RELATIONSHIPS. We consider that three species comprise the genus *Melichthys*:

Melichthys niger (Bloch) is described above.

Melichthys vidua (= *Balistes vidua* Solander in Richardson, 1844, p. 128, pl. 59, figs. 9, 10; type locality, Otaheiti = Tahiti; probable holotype in BMNH, according to Günther, 1870, p. 217). This species ranges from South Africa eastward to Hawaii and the Tuamotu Islands. Its pigmentation is characterized by a black (or brown) head, body, and first dorsal fin; the caudal fin and posterior part of the peduncle clear, with a thin black margin around

the caudal fin on some specimens; and clear second dorsal, anal, and pectoral fins with a narrow black margin around the second dorsal and anal fins and on the distal part of the pectoral fins. Seven to 10 longitudinal ridges occur on the peduncle and posterior part of the body. All teeth have well developed cusps in most specimens examined up to 156 mm. SL, but in the largest specimen examined, 215 mm. (BC 60-220), the median teeth are truncate and the lateral teeth have smooth cusps. We have not observed a prejuvenile stage of this species, but the smallest specimen examined, 92 mm., in a series with five other specimens, 99–156 mm. (USNM 168545-50), has the lightest body pigment of any we have seen. This species has been placed in the genus *Balistes* by most authors, who have at the same time placed *niger* (as *radula*) in *Melichthys*.

Melichthys nycteris (= *Pachynathus nycteris* Jordan and Evermann, 1903, p. 199; type locality, Honolulu; holotype 133 mm. SL, USNM 50821). We have examined three specimens of this species, the holotype, a 95-mm. specimen from Honolulu (ANSP 77704), and a 93.5-mm. specimen from off Thailand in the Andaman Sea (ANSP uncataloged). Fowler (1928, p. 450) recorded two specimens from Honolulu in the B. P. Bishop Museum [Fowler's plate XLIV, fig. B, labeled *Balistes vidua*, is *M. nycteris*]. Fowler (1946, p. 213, fig. 73) described another specimen of this species as a proposed new genus and new species, *Oncobalistes erythropterus*, from Aguni Shima, Riu Kiu Islands (holotype ANSP 72087). The pigmentation of this species is characterized by a black (or brown) head, body, and peduncle; the caudal fin dusky to relatively clear; the pectoral fins clear with a narrow, dusky posterior margin; and the second dorsal and anal fins with narrow dark margins and with three or four narrow longitudinal stripes in the second dorsal fin and with two such stripes in the anal fin. Orbital bands, similar to those in *M. niger*, are visible on the smallest specimen. The three specimens examined have about 14 indistinct, longitudinal ridges on the posterior part of the body and peduncle, and all teeth have well developed cusps.

The following mean fin ray counts suggest intraspecific and interspecific differences in the three species of *Melichthys*:

	Number	Dorsal	Anal	Pectoral
<i>M. niger</i> , eastern Pacific	26	32.4	29.1	15.1
<i>M. niger</i> , central-western Pacific	24	32.5	29.3	15.2
<i>M. niger</i> , Atlantic	6	33.4	30.0	16.1
<i>M. vidua</i>	11	33.4	29.4	14.1
<i>M. nycteris</i>	3	33.3	29.7	14.3

In this small sample, *M. niger* from the Atlantic averages one more ray in each fin than *M. niger* from the Pacific, and *M. vidua* and *M. nycteris* average one fewer pectoral ray and one more dorsal ray than Pacific *M. niger*.

SYNONYMY. *Melichthys niger* (Bloch 1786) is the earliest available name for this species, and we consider it to be the valid name. We discovered this

name, originally proposed as *Balistes niger*, and used it for the species in an early 1964 draft of this manuscript. Later that year we concluded that *Balistes niger* Bloch, 1786, had not been used as senior synonym since it was originally described, and we concluded that it presumably qualified as a *nomen oblitum* under the somewhat inexact provisions of Article 23(b) of the International Code of Zoological Nomenclature (1961, p. 23).

In late 1964, W. I. Follett advised us that, under the provisions of the second edition of the International Code of Zoological Nomenclature Adopted by the XV Congress of Zoology (1964, p. 11), the name *Melichthys radula* (Solander in Richardson, 1848, p. 22) was the valid name for this species. This name was not valid according to Article 11(d) of the first edition of that Code (1961, p. 11), because it had originally been described, however incorrectly, in synonymy of another species (see below). The 1964 edition of the Code validated *Balistes radula* Solander, because "prior to 1961" it had "been treated as an available name with its original date and authorship" and it had been "adopted as the name of a taxon."

Three factors have now (15 July 1966) made us reject *Balistes radula* Solander and accept *Balistes niger* Bloch as the valid name for the black triggerfish. Article 23(b) of the Code has been suspended by the International Commission of Zoological Nomenclature (W. I. Follett and Lillian J. Dempster, personal communication). The name *Melichthys niger* (Bloch) has been published as the senior synonym of this species by Mago Leccia (12 July 1965, p. 411). The rejection of *radula* in favor of *niger* does not overtly contravene the desired principle of stability in nomenclature, because, although *radula* has most frequently been used for this species, the species name has also frequently been confused (see below).

Osbeck (1757, p. 295) defined this species and published its first Latinized binomial, *Balistes nigra*, based on specimens from Ascension Island in the South Atlantic Ocean. One year later, in the initial nomenclaturally acceptable publication in zoology, Linnaeus (1758, p. 329) incorrectly included Osbeck's *Balistes nigra* in synonymy of the species that Linnaeus named *Balistes ringens* [recognized by us as *Xanthichthys ringens*]. Linnaeus (1766, p. 409) repeated this error, with the addition to synonymy of the reference to Gronow's manuscript. The "thirteenth edition" of Linnaeus's *Systema Naturae*, edited and emended by Gmelin (1788, p. 1469), adhered to Linnaeus's prior usage and added several references in synonymy, including the description of *Balistes niger* by Bloch (1786, p. 27 and pl. 152, fig. 2).

In the meantime, Osbeck's 1757 work had become nomenclaturally acceptable through two post-1758 translations. In the translation to German (1765, p. 386) by Georgi, *Balistes nigra* of the original publication was replaced by *Balistes ringens*. In the introduction to his translation of the German edition to English (1771, vol. 1, p. x), Forster stated that Osbeck had revised and made

additions to the German translation. Presumably then, Osbeck adhered to Linnaeus's opinion of 1758 and substituted "ringens" for "nigra" in the 1765 edition. In the English edition (1771, vol. 2, p. 93) this name was given as "*BALISTES ringens* Linn. *Nigra* Osbeck," where the reference to the original use of "nigra" by Osbeck was apparently inserted by Forster.

Bloch (1786, p. 27–28, pl. CLII, fig. 2) described and illustrated this species, and his is the earliest nomenclaturally acceptable name we can locate. He cited Lister (in Willughby) as the first to publish on this species and Willughby (1686, app., p. 21; app., pl. I, fig. 24) as the first to illustrate it. Bloch recognized that his *Balistes niger* was identical with a fish described by Osbeck, but he referred only to the post-1758 translation of Osbeck (1765, p. 386, where Osbeck's name was given only as *Balistes ringens*), and he erroneously considered Osbeck's description to have been based on specimens from China. Because Bloch did not refer to the 1757 and 1771 editions of Osbeck (where "nigra" was used), we consider that he was proposing a new specific name for this species, and that authorship of "niger" should be credited to Bloch. De Beaufort (1962, p. 283) placed "niger" of Bloch in questionable synonymy of "radula" Solander.

Additional confusion was introduced when the figure complementing Bloch's description of *B. niger* (pl. CLII, fig. 2) was incorrectly captioned "BALISTES RINGENS." The figure is a creditable portrayal of *M. niger*, although it shows five truncate teeth on the right side.

In a publication two years after Bloch's, Bonnaterre (1788) capitalized on this awkward situation. His description of "LE SILLONÉ 10. *B. ringens*" (p. 19) is of *Xanthichthys*, and the habitat was given as "L'Isle de l'Ascension." He copied Bloch's figure of *M. niger* (which Bloch had incorrectly labeled *B. ringens*) to illustrate this (pl. 12, fig. 39, as "Le Sillonné"). Then Bonnaterre proposed *B. niger* as a new name to identify his "LE BALISTE NOIR" (p. 19, pl. 85, fig. 352), which according to the illustration and to de Beaufort (1962, p. 288) is the species currently recognized as *Balistes* [*Balistapus*] *conspicillum* Bloch and Schneider 1801.

In the treatment by Bloch and Schneider (1801, p. 472), *M. niger* was described and discussed in the genus *Balistes* under the specific name of "VINGENS."

Swainson (1839, p. 325) perpetuated the problem by listing the first species under his new genus, *Melichthys*, as "ringens. Bl. pl. 152.2." Bloch's species has been considered as the type species of *Melichthys* by most revisers of Swainson. The proper designation of this type species should be *Balistes ringens* Bloch (not Linnaeus), 1786, pl. 52, fig. 2 = *Balistes niger* Bloch 1786, p. 27. Günther (1870, p. 227) attempted to emend Swainson's genus to a subgenus with the spelling of *Melanichthys*.

Günther (in Playfair and Günther, 1866, p. 135) gave the specific name of

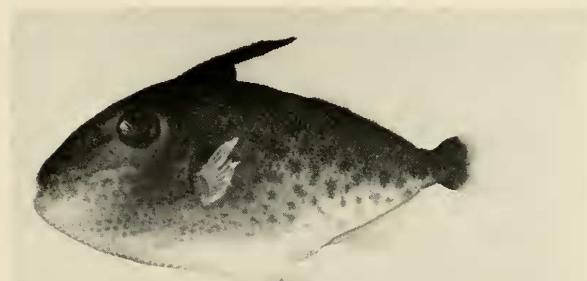


FIGURE 12. *Xanthichthys mento*, 55 mm. SL, Clipperton Island, UCLA W58-281.

this species as “*niger*,” which he considered to be a classical emendation of Forster’s addition of “*Nigra*” to the 1771 translation of Osbeck. Günther did not refer to the 1786 work of Bloch, and later (1870, p. 227), he still further confused the issue by incorrectly considering the *Balistes buniva* of Lacépède to be a senior synonym of this species.

In addition to the publication of “*niger*” by Bloch and by Bonnaterre as a new specific name for different species of Balistidae, there are at least two other such proposals: *Balistes niger* Mungo Park (1797, p. 37) is currently recognized as *Balistes [Sufflamen] chrysopterus* Bloch and Schneider 1801; and *Xenodon (Balistes) niger* Rüppell (1835, p. 53, pl. XV, fig. 2), currently recognized as *Balistes [Odonus] erythrodon* Günther 1870 (according to de Beaufort, 1962, pp. 292 and 295).

Richardson (1848, p. 21, pl. 6) described and illustrated this species under the name of *Balistes ringens* Bloch, based on the figure by Bloch (1786, pl. CLII, fig. 2). At the conclusion of his treatment, Richardson published, for the first time and in synonymy of *Balistes ringens*, the name and description of *Balistes radula* Solander from Solander’s manuscript, *Animalia Oceani Pacifici*. The 1964 edition of the Code affords validation of *Balistes radula* Solander, because “prior to 1961” it had “been treated as an available name with its original date and authorship” and it had been “adopted as the name of a taxon.” The first published use of *Melichthys radula* (Solander 1848) in the above context that we have found is by Jenkins (1903, p. 483). The use of this name was perpetrated by Snyder (1904, p. 534) and by Jordan and Evermann (1905, p. 417), and this is the name that subsequently has been applied most often to the species (see de Beaufort, 1962, p. 283).

Two other names have been used a number of times for this species: 1) *Balistes buniva* Lacépède (1802, pp. 668–670, pl. 21, fig. 1; type locality, Nice, France). The description and illustration are not of a *Melichthys*. Briggs

(1961, p. 554) was correct in suggesting that Lacépède's *buniva* should be retained in synonymy of *Balistes capriscus* Gmelin (1788), but *M. buniva* frequently has been used for *M. niger* in the Pacific (see Clark, 1949, p. 9 and fig. 2, not p. 2; Gosline and Brock, 1960, pp. 294 and 343). 2) *Balistes piceus* Poey (1863, p. 180). This is a junior synonym of *M. niger*, and often has been applied to this species in the West Indies (see Jordan, Evermann, and Clark, 1930, p. 493).

Xanthichthys mento (Jordan and Gilbert).

Redtail Triggerfish.

(Figures 12, 13.)

Balistes mento JORDAN and GILBERT, 1882, p. 228 (type locality, Clarion Islands, Revillagigedos; holotype USNM 28387).

Xanthichthys gotonis TANAKA, 1918. TANAKA, 1935, p. 481, pl. CXXXI, fig. 372 (type locality, Sagami Sea) [male].

Xanthichthys purus TANAKA, 1918. TANAKA, 1935, p. 484, pl. CXXXII, fig. 374 (type locality, Sagami Sea) [female].

Body moderately elongate and shallow; caudal peduncle moderately compressed; snout and head profile convex, almost straight on some specimens.

Scales covering head and body. Conspicuous horizontal grooves on cheek below eye, usually five grooves of which the three median ones are the most pronounced, occasionally six and rarely four grooves; a single row of enlarged scales between each groove. Diagonal grooves between scales on body, less pronounced than those on cheek. Area on sides posterior to soft dorsal fin origin with about 10 to 13 weak, irregular ridges produced by spinules on scales. No enlarged scales behind gill opening. Incasing scales of pelvis movable. Preorbital groove moderately deep and pronounced.

Teeth with strong cusps, the cusps slightly reduced on the two lateral pairs of upper jaw teeth in large specimens, and all teeth with a dark tinge in larger specimens; median pair of upper jaw teeth smaller than adjacent pair.

D. III, 28–32; A. 25–29; P₁ 12–13 (table 1). Third spine of dorsal fin minute at all sizes, not extending above the dorsal surface of the body. Soft dorsal and anal fins developing slightly produced anterior lobes by 54.5 mm. SL, the 3rd or 4th rays the longest in the fins. Caudal fin rounded in small specimens, becoming bifurcate by about 100 mm., dorsal and anal lobes produced. Scale rows 42–43 (3 specimens). Gillrakers 40–47 (5). Vertebrae 7 + 11 (3).

PIGMENTATION. Sexual dimorphism exists in pigment pattern of adults.

Males (fig. 13A). The dark head contrasts with the lighter body. The throat and ventral surface of the body are slightly lighter than the rest of the body. A small rounded dark spot occurs in the center of most of the lighter colored scales on the body and throat; the interscale grooves are a contrasting darker shade as are the dorsal and anal fin sheaths. The soft dorsal and anal

fins are nearly clear (unpigmented); the proximal parts of a few of the rays are dusky. The pectoral fins may be slightly dusky. The caudal fin is dusky with an almost clear lunate margin.

Females (fig. 13B). The pigmentation is generally darker than in males. There is little contrast in head and body pigment density (as with males). The ventral surfaces are slightly lighter than the remainder of the body. Small rounded spots occur on a few scales of some specimens, but these are usually indistinct. The dark grooves between the scales are more pronounced than in males. The soft dorsal and anal fin rays are pigmented throughout their length, and the interradial membranes are clear, so that the fins appear dark distally. Pigmentation of the pectoral and caudal fins is similar to that in the males, except that the clear distal margin of the caudal is slightly wider in females.

Small juvenile specimens are dark above and light below; the interspinous membrane is black with a smaller clear area around the second spine, the other fins are clear; dark spots form on the upper part of the sides by 23.6 mm. SL; these spots increase in number and extend down the sides in larger juveniles (fig. 12).

Tanaka (1918) described two new species of *Xanthichthys* and later (1931, p. 5) recognized the type specimens as different sexes of the same species (Tanaka placed his *X. gotonis* and *X. purus* in synonymy of *X. lineopunctatus*; we consider them to be junior synonyms of *X. mento*). Tanaka's colored drawings of these two specimens (1931, pl. II) show appreciable differences in coloration, the male with a red tail, yellow body with light blue spots, and a deep blue head, and the female with a yellowish tail, bluish green body, and light blue head.

The description of the "coloration in spirits" of the holotype of *X. mento* indicates that this was a female. The type specimen was searched for in the U. S. National Museum on 9 March 1964 but was not found.

RANGE. Primarily oceanic, particularly around oceanic islands, and presumably ranging across the entire north Pacific. We have examined specimens taken at a number of offshore localities in the eastern North Pacific from Guadalupe Island to Clipperton Island (fig. 19). *Xanthichthys mento* has been reported from Santa Catalina Island and San Diego, California, by Jordan (1919, p. 2; 1924, p. 82). The occurrence of this species at Easter Island in the eastern South Pacific (USNM 65700, MCZ 29627), and its apparent absence between there and Clipperton Island, suggest an antitropical distribution in the eastern Pacific. If *X. mento* occurs at Cocos or the Galápagos Islands, it should have been collected there. This species was reported to be "Not common" at Hawaii (Gosline and Brock, 1960, p. 293), but United States museums contain a number of Hawaiian specimens, and the smallest specimens of *Xanthichthys* we have seen were caught in Hawaiian waters (18.2–21.5 mm. SL; USNM 118057, SIO 60-253). We have not checked many other records

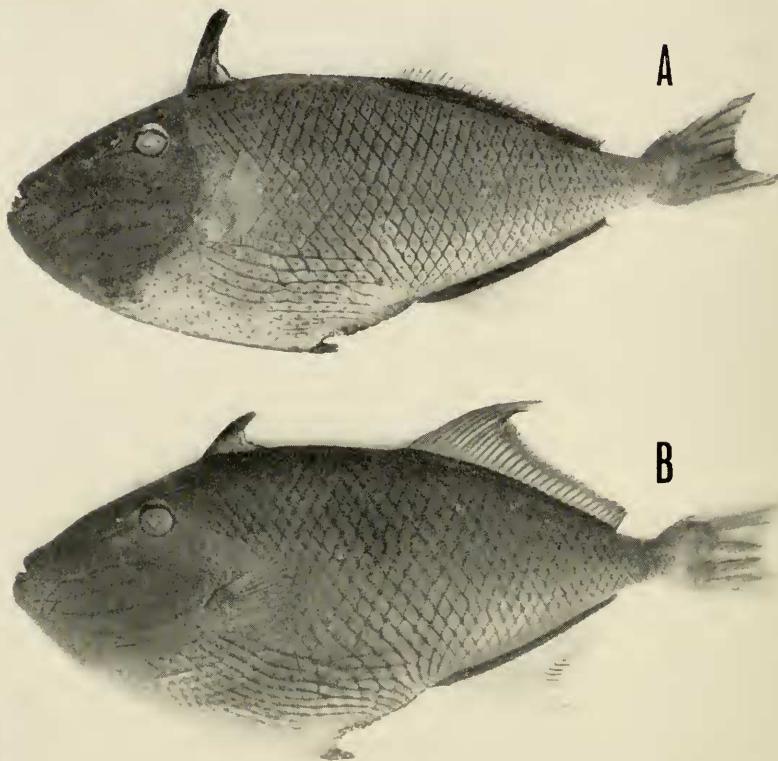


FIGURE 13. *Xanthichthys mento*. A, male, 203 mm. SL, UCLA W52-82. B, female, 208 mm. SL, UCLA W52-141. Both from San Benedicto Island, Revillagigedo Islands.

of this species from the central and western Pacific. Kuroda (1961, p. 70, fig. 2) described the live coloration of a specimen (as *X. lineopunctatus*) from Zensu Island ($30^{\circ}56'N$, $138^{\circ}49'E$). Kamohara (1957, p. 55) reported on a specimen (as *X. lineopunctatus*) from Ankyaba, Amami-Oshima, Japan. Fowler (1928, p. 451) recorded a specimen (as *B. ringens*) in the U. S. National Museum from Fiji, collected by the Wilkes Expedition, although this was not recorded in his later list of "The fishes obtained by the Wilkes Expedition, 1838-1852" (Fowler, 1940, p. 797). We presume the record from Nauru to represent *X. mento* on the basis of its distribution, although the two specimens recorded from there were only listed (as *Xanthichthys ringens* (Linné)) and were not described (Whitley and Colefax, 1938, p. 299).

RELATIONSHIPS. We tentatively conclude that the genus *Xanthichthys* contains three species.

Xanthichthys ringens (Linnaeus 1758) in the western Atlantic is characterized by two or three pigmented grooves below the eye and dark spots at the apices of most of the body scales. This name is not definitive. Linnaeus' description (1758, p. 329) was based on at least two species, one which we consider to be the western Atlantic *Xanthichthys*, and the *Balistes nigra* of Osbeck (1757) from Ascension Island with the valid name of *Melichthys niger* (Bloch). Linnaeus' earlier account of *Balistes ringens* (1754, p. 58) is also confusing, because it was based in part on Willughby (1686, p. 152, pl. 19), which appears to have represented *Balistes capriscus*, and Linnaeus recorded the habitat as "in Europa australi." His record of habitat in 1758 as "ins. Ascensionis" was obviously biased by Osbeck's account. However, excluding those taken from Osbeck, the fin ray counts Linnaeus recorded in both 1754 and 1758 apply to *X. ringens* as we know it, and from his descriptions it seems possible that he had a specimen of this species. If we correctly interpret two of his descriptive terms, they apply to the two or three pigmented grooves under the eye of *X. ringens*—"Balistes lateribus capitis triplicatis" and "Latera capitis plicis 3 mobilibus."

Xanthichthys lineopunctatus (Hollard, 1854), known from South Africa to Mauritius (type locality, Bourbon Island = Reunion), has three to five pigmented grooves below the eye. It is similar to *X. ringens* in having dark spots at the anterior apices of the scales on the ventral third of the body, and these form about six horizontal rows of spots. Scales along the lateral midline of the body have about two rows of spots, elongated into dashes which extend posteriad from the anterior scale apex to about one-third of the scale length. On the upper part of the body these dashes are coalesced to form seven or eight narrow, irregular stripes. This pigmentation was illustrated by Smith (1961, pl. 90, fig. 1165). We have examined two adult *X. lineopunctatus* from South Africa (ANSP 90575, 90648) that appear to have the distinctive pigment pattern described for the type of the species by Hollard (1854).

Xanthichthys mento of the Pacific differs from the other two species in having usually five pigmented grooves below the eye and in not having apical spots on the body scales (see pigment description above).

Thus it appears that there are at least three disjunct populations of *Xanthichthys*, which differ in pigmentation, and which we have recorded as three distinct species. De Beaufort (1962, p. 309) remarked on the great gap in known distribution of *Xanthichthys* between Mauritius ($57^{\circ}46'E.$) in the west and Nauru ($165^{\circ}56'E.$) in the east. Yet we have seen a small specimen of *Xanthichthys*, which we cannot specifically identify, in the uncataloged USNM collections from the Andaman Sea — nearly in the middle of the hiatus previously thought to exist. Obviously, our current statements on ranges are imperfect, and our conclusions on taxonomy of this genus are tentative.

SYNONYMY. Most citations give the year of publication of Jordan and Gilbert's description of *Balistes mento* as 1881, and pages 225 and 241 (including the description on page 228) have the date December 24, 1881, printed at the bottom. However, Bulletin 193 of the U. S. National Museum, "A list and index of the publications of the United States National Museum (1875-1946)," gave the date of publication of this number as January 4, 1882.

The pigment characters by which we distinguish the three species of *Xanthichthys* develop at about 80 to 140 mm. SL. Without a knowledge of location of capture we cannot identify to species small specimens lacking the specific pigment pattern. Three nominal species in this category predate *X. mento*:

Balistes aureolus Richardson (1844, p. 126, pl. 59, figs. 1-4) is a *Xanthichthys* and has frequently been cited as a synonym of *X. ringens*; however, this is a small specimen of about 58 mm. SL (type in the British Museum of Natural History, according to Günther, 1870, p. 215), and the collection locality is uncertain — Richardson stated, "Sir Edward Belcher did not note the locality in which this fish was taken."

Balistes notatus Gronovius in Gray (1854, p. 36) is a *Xanthichthys* and has been placed in synonymy of *X. ringens* by Jordan and Evermann (1898, p. 1709), who gave the locality of that nominal species as "both Indies." Wheeler (1958, p. 245) listed the holotype of *B. notatus* (BMNH 1853.11.12.188), 133 mm., as a synonym of *X. ringens*, but did not record a type locality.

Balistes heckeli von Müller (1864, p. 182) from "Mexico" has been placed in the synonymy of the Atlantic *X. ringens* (see Jordan and Evermann, 1898, p. 1709), but we have not determined if von Müller's specimen came from the Atlantic or the Pacific coast of Mexico.

Canthidermis maculatus (Bloch).

Ocean Triggerfish, Ocean Turbot, Rough Triggerfish.
(Figures 14, 15, 16.)

Balistes maculatus BLOCH, 1786, vol. 2, p. 25, pl. CLI (type locality, "in den amerikanischen Gewässern").

Balistes americanus GMELIN, 1788, p. 1473 (type locality "in Oceano americano," holotype BMNH 1853.11.12.193, 32 mm. SL, according to Wheeler 1958, p. 245).

Balistes macropterus WALBAUM, 1792, p. 465 (type locality, "in oceano Americano").

Balistes rotundatus PROCÉ, 1822, p. 130 (type locality, "la baie de Manille").

Balistes angulosus QUOY and GAIMARD, 1824, p. 210 (type locality, Sandwich (= Hawaiian) Islands; holotype MNHN B. 1921, 83 mm., 3 paratypes from Hawaiian Islands, New Guinea, and an unknown locality, according to Le Danois 1961, p. 518).

Balistes azureus LESSON, 1830, p. 121, pl. 10, fig. 2 (type locality New Guinea; holotype MNHN B. 1809, 150 mm.; one paratype from Bora-Bora, Society Islands, according to Le Danois 1961, p. 518).

Balistes oculatus GRAY, 1831, vol. 1, pl. 90, fig. 1 (type locality, India; date of publication according to Sawyer, 1953, p. 51).

Balistes willughbeii LAY and BENNETT, 1839, p. 68, pl. XXI, fig. 2 (type locality, Acapulco,

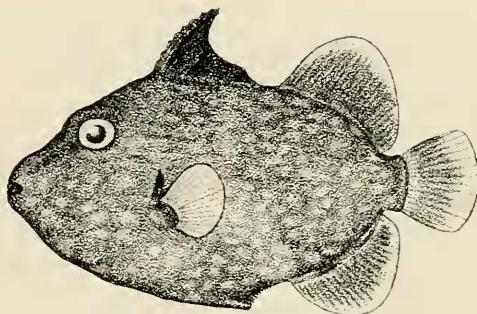


FIGURE 14. *Canthidermis maculatus*, 32 mm. SL, 10 miles S. of Morro Puercas, Panama, UCLA W49-466.

Mexico; counts of soft rays low, D. 20, A. 17, but the figure obviously = *C. maculatus*).

Balistes adspersus TSCHUDI, 1845, p. 31 (type locality, Huacho, Peru).

Balistes senticosus RICHARDSON, 1848, p. 23, pl. 9, figs. 5-8 (type locality, Seas of China; holotype in BMNH according to Günther, 1870, p. 215).

Balistes brevissimus HOLLARD, 1854, p. 56, pl. III, fig. 1 (type localities, "Nouvelle-Guinée et l'Australie").

Balistes longissimus HOLLARD, 1854, p. 60, pl. III, fig. 3 (type locality, Vanikoro, Santa Cruz Islands, Society Islands; holotype MNHN B. 1806, 412 mm., according to Le Danois, 1961, p. 519).

Balistes rufus GRONOVIIUS in Gray, 1854, p. 36 (type locality, "in Oceano americano," holotype BMNH 1853.11.12.193, 32 mm. SL, according to Wheeler, 1958, p. 245).

Balistes longus GRONOVIIUS in Gray, 1854, p. 37 (according to Günther, 1870, p. 214).

Balistes um THIOLLIÈRE, 1857, p. 217 (type locality, Woodlark Island; according to Fowler, 1928, p. 449).

Balistes munumum THIOLLIÈRE, 1857, p. 217 (type locality, Woodlark Island; according to Fowler, 1928, p. 449).

Balistes melanopterus COPE, 1871, p. 478 (type locality, Darien).

Canthidermis viola HERRE, 1926, p. 534, pl. 1 (type locality, Manukan, Cagayan Islands, Sulu Sea).

Canthidermis longirostris TORTONESE, 1954, p. 77, fig. 1 (type locality, "Mar Rosso"; holotype no. 20162 in Dahlak. Mus. Civ. Zoologia, Roma).

Body elongate, becoming more so with increase in size; caudal peduncle compressed; head profile slightly to moderately convex.

Scales covering entire body. No pronounced grooves between scale rows on head or body. Elevations on scales forming slightly irregular ridges on head and body at smaller sizes, these becoming less pronounced and tending to disappear at about 175 mm. SL. No enlarged scales behind gill opening. Incasing scales of pelvis fixed and immovable. Preorbital groove moderately deep and pronounced. Teeth with strong cusps at all sizes, except the two medial teeth of upper jaw tending to lose cusps at about 400 mm.

D. III, 23-25; A. 20-23; P₁ 13-15 (table 1). Third spine of dorsal fin

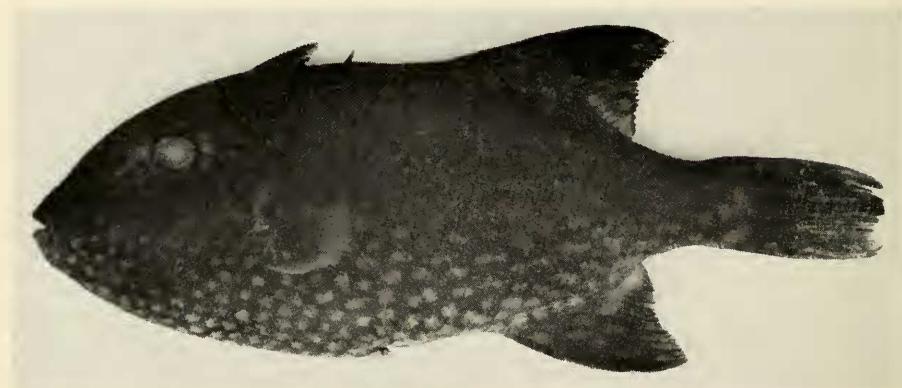


FIGURE 15. *Canthidermis maculatus*, 161 mm. SL, 150 miles SW. of Acapulco, Mexico, SIO 62-168.

becoming relatively small in larger fish (above about 150 mm. SL); second spine also reduced in very large specimens. Soft dorsal and anal fins becoming falcate in specimens larger than about 110 mm. SL, usually with fourth or fifth dorsal and third or fourth anal rays the longest. Caudal fin rounded at small sizes, becoming biconcave at about 100–150 mm. SL, and the median lobe almost disappearing and the dorsal and ventral lobes pronounced at about 400 mm. SL. Scale rows 36–41 (3 specimens). Gillrakers 24–32 (13 specimens, 45–242 mm.) and about 39 at 482 mm. Vertebrae 7 + 11 (2 specimens).

PIGMENTATION. Larger juveniles and adults (figs. 15 and 16): Body and head brown, lighter on ventral surfaces, with a number of horizontally elongate spots all over, spots continuing onto dorsal and anal fins and frequently onto caudal fin; the spots less pronounced or missing from some preserved specimens larger than 400 mm. SL (the fins dark brown on these large specimens). Smaller juveniles (fig. 14): Usually with a number of white spots over the body, and a dark first dorsal fin; specimens varying in amount of spotting on soft dorsal and anal fins, and in intensity of dark pigmentation on head and body.

RANGE. This world-wide species is found inshore in tropical waters, but records indicate that it also inhabits the surface waters of the open ocean without apparent association with land. In the eastern Pacific, it has been recorded from Huacho, Peru (Tschudi, 1845, p. 31, as *B. adspersus*), and we have examined specimens from most of the offshore islands and from Colombia to off central Mexico (fig. 19). It was recorded from numerous Indo-Pacific localities by de Beaufort (1962, p. 311, as *C. rotundatus*).

RELATIONSHIPS. We believe that this oceanic species has a continuous distribution from the eastern Pacific westward to the western Atlantic. We can

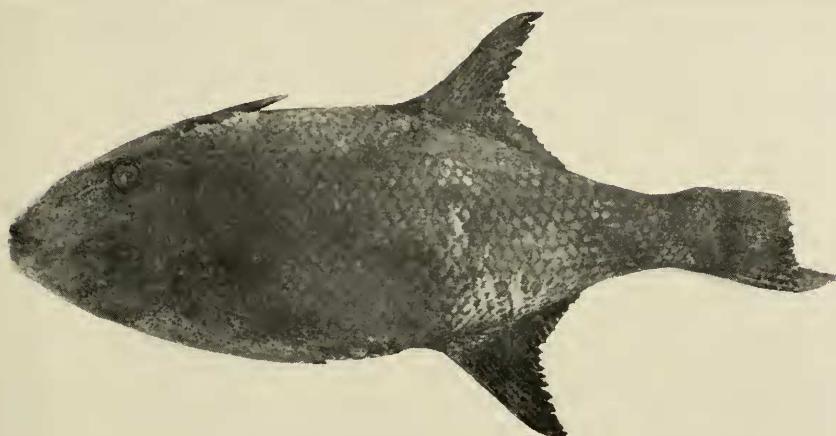


FIGURE 16. *Canthidermis maculatus*, 482 mm. SL, Clipperton Island, UCLA W56-236.

find no significant differences in large series of specimens from both sides of the American continents. Specimens from various Indo-West-Pacific localities are similar to the American specimens in all respects noted. We are aware of only one other species of *Canthidermis*, *C. sufflamen* (Mitchill) (= *C. sobaco* Poey) of the western Atlantic. This second species has higher numbers of dorsal softrays (25–28) and anal softrays (23–25) — Donald Moore, personal communication.

SYNONYMY. The synonymy of this species has been confused because identifications and names based on small specimens (as “*rotundatus*” Procé and “*oculatus*” Gray) have not been recognized as conspecific with larger, more elongate specimens (as “*maculatus*” Bloch, “*willughbeii*” Lay and Bennett, and “*longirostris*” Tortonese). As the body length increases, there is a proportionate decrease in head length, eye diameter, body depth, and first dorsal spine length, and a proportionate increase in the lengths of the lobes of the dorsal and anal fins. These relations can be visualized in table 2. This species has usually been identified as “*maculatus*” in the Atlantic, as “*rotundatus*” in the Indo-West-Pacific, and as “*adspersus*,” “*rotundatus*,” “*angulosus*,” or “*maculatus*” in the eastern Pacific.

SPECIMENS EXAMINED

Collection numbers (and pertinent data for uncataloged specimens) from eastern Pacific localities only are listed. Most of these specimens are plotted in figures 17, 18, and 19.

Balistes polylepis (fig. 17). UCLA W49-53, W49-55, W50-24, W50-34,

W50-43, W50-188, W51-16, W52-40, W52-45, W53-357, W53-370, W54-366, W55-96, W55-97, W55-122, W55-139, W55-160, W56-111, W56-115, W56-137, W56-276, W56-376, W58-37, W58-46, W58-71, W58-132, W59-13, W60-15, W60-26, W60-97, W60-106. SIO H49-178, H50-79, H50-105, H53-178, 59-281, 60-294, 60-311, 60-355, 60-356, 60-511, 62-18, 62-54, 62-59, 62-65, 62-214, 62-236, 62-703, 62-715, 63-482, 64-63, 64-805, 64-814. LACM W51-108, W59-200, W60-38. ANSP 88972, 88973. CAS 5365, IU13431a, W58-48. SU 6878, 16639, 48174. USNM 165496. BLLJ uncataloged, D5011, 23°00.5'N., 109°34'W., 30 September 1952, stomach contents of *Coryphaena*; S5708, 111G14; Mexico, Magdalena Bay, 28 September 1952; 14°28'N., 92°58'W., 6 February 1962, FB62-186; Ceralbo Island, 29 July 1962, FB62-292; Mexico, Cedros Island, 2 November 1961; D-20, 157.20; 25°37'N., 110°37'W., 17 September 1956; Mexico, 12 miles W. of Magdalena Bay, 18 October 1956; S5708, 153.16; S5708, 99G40; TO-5801-141; S5708, 104G00. BLSD uncataloged, 06°30'N., 82°23'W., 26 April 1963; 09°45'N., 83°37'W., 8 May 1963; 17°22'N., 101°28'W., 16 March 1963.

Pseudobalistes naufragium (fig. 17). UCLA W51-3, W51-43, W51-58, W55-91, W56-114, W56-115, W58-5, W62-63. SIO 62-63. ANSP 77873. BC 59-674. CAS IU13432a. MCZ uncataloged, Panama, Pt. Partilla, 29 April 1962. SU 1656, 6877, 9305. USNM 53485, 65434. BLLJ uncataloged, Mexico, Banderas Bay, 19 August 1961; B6108-31, Mexico, Banderas Bay, 18-19 August 1961.

Sufflamen verres (fig. 18). UCLA W51-43, W51-54, W51-243, W51-252, W51-273, W52-263, W53-126, W53-157, W53-168, W53-293, W53-370, W55-118, W55-161, W56-161, W56-234, W56-235, W56-236, W58-11, W58-37, W58-202, W58-222, W58-287, W58-378, W59-248, W60-139, W60-148, W60-151, W60-176, W61-34. SIO H49-75, H51-61, 58-210, 59-219, 61-237, 61-243, 61-249, 61-250, 61-252, 61-279, 62-20, 62-25, 62-55, 62-58, 62-63, 62-341, 62-726. AHF 2350, 77-61. ANSP 100279. BC 60-464. CAS 6036, 6037, W54-225. MCZ 11872, 36523, 36524. SU 6805, 6905. USNM 47469, 73156. BLLJ uncataloged, B6212-3; Costa Rica, 5 miles SE. of Cabo Blanco, 12 March 1959; Costa Rica, off Cape Velas, September 1959, FB62-253; 11°34.4'N., 87°00'W., FB62-254; Mexico, Cleopha Island, 21-22 August 1961.

Melichthys niger (fig. 18). UCLA W51-266, W53-52, W53-126, W55-52, W55-163, W56-236, W58-378. SIO 59-334, 62-341. ANSP 86278, 89117. BC 54-402, 56-239, 56-361, 56-364, 57-143. CAS 919, 6035. SU 10879, 12338, 12581, 12582. USNM 5988 (locality unknown).

Xanthichthys mento (fig. 19). UCLA W51-92, W51-156, W51-274, W52-81, W52-82, W52-141, W55-123, W55-136, W55-150, W58-281. SIO H49-51, H53-173, 57-72, 57-138, 58-54, 58-139. CAS 1974, 1976, 1977, W53-44, W53-47, W55-127. MCZ 27911, 29374, 29627. SU 6366. USNM 47128, 47129, 47130, 65700. BLLJ uncataloged, H5612, 157.60.

Canthidermis maculatus (fig. 19). UCLA W49-466, W51-266, W53-207,

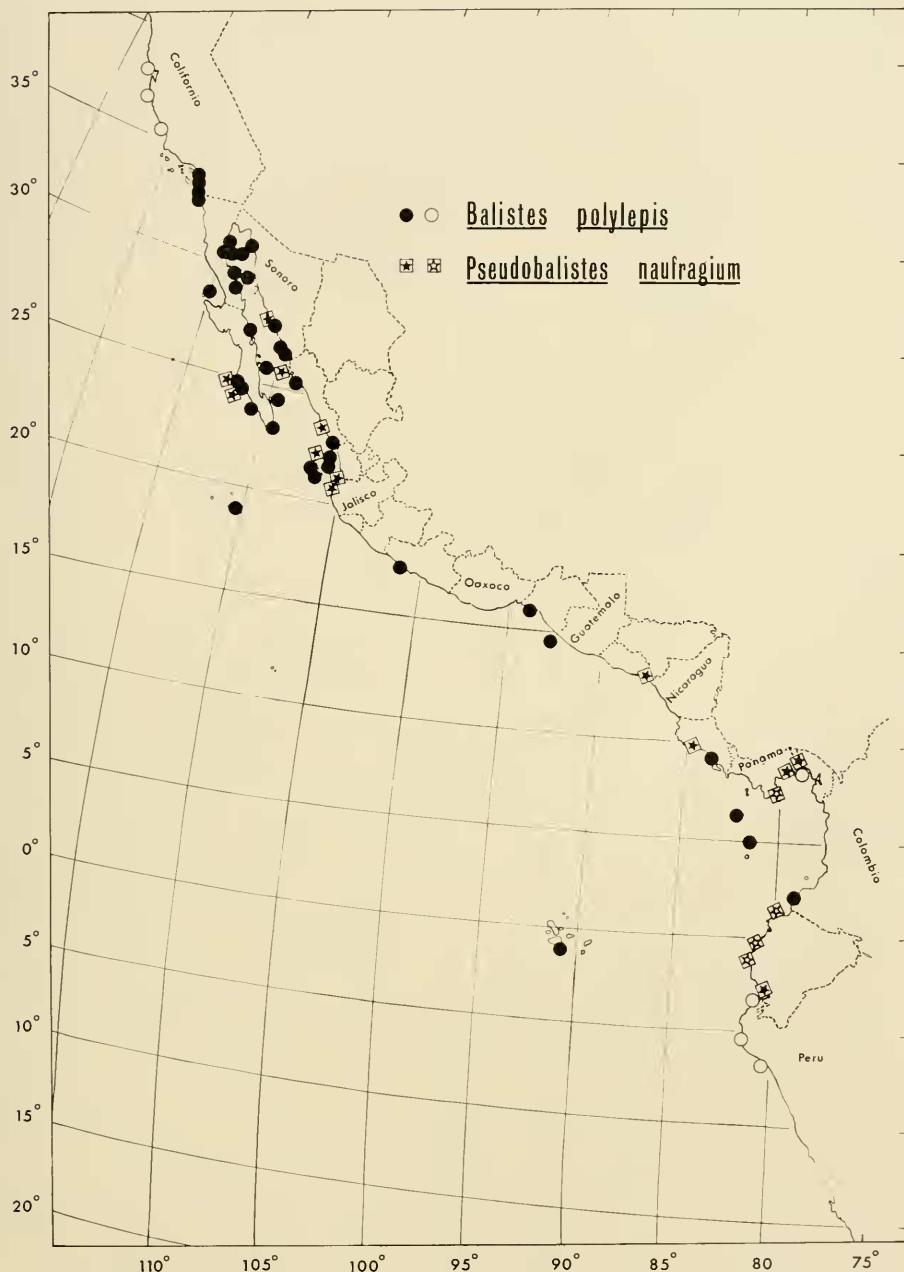


FIGURE 17. *Balistes polylepis* and *Pseudobalistes naufragium*—distribution in the eastern Pacific. Solid symbols represent specimens examined; open symbols represent literature reports. The northernmost record for *B. polylepis* is not shown (41°50'N., 124°22'W.).

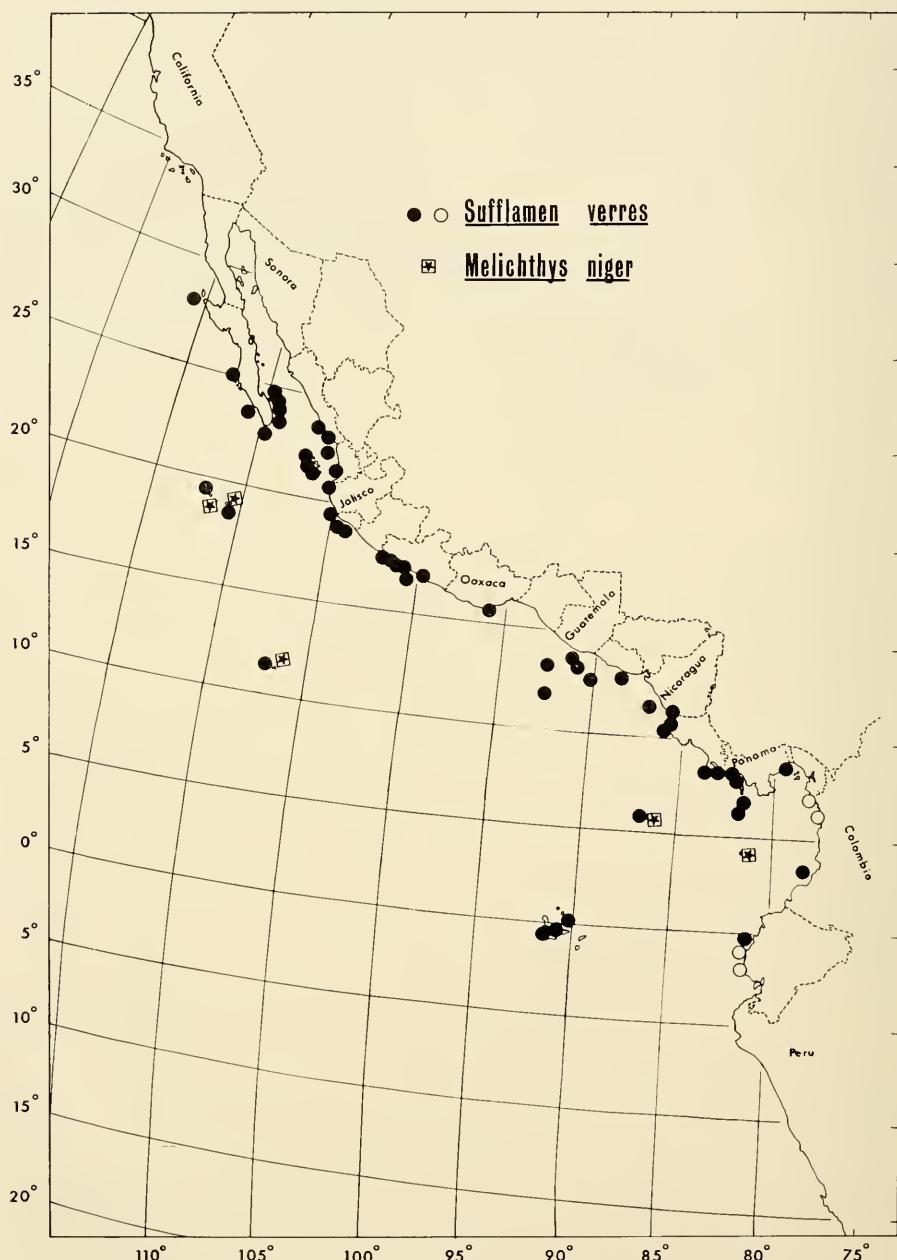


FIGURE 18. *Sufflamen verres* and *Melichthys niger*—distribution in the eastern Pacific. Solid symbols represent specimens examined; open symbols represent literature reports.

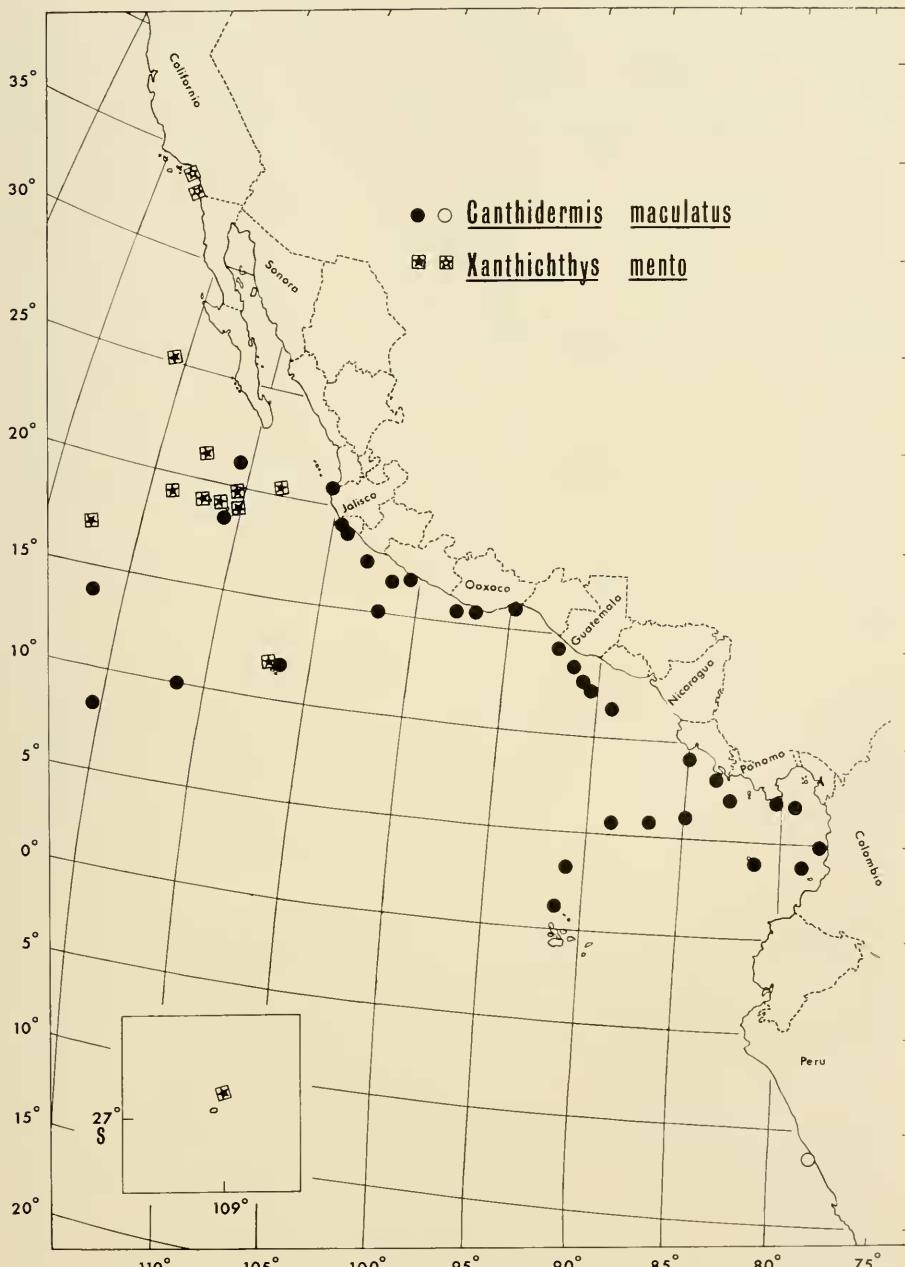


FIGURE 19. *Xanthichthys mento* and *Canthidermis maculatus*—distribution in the eastern Pacific. Solid symbols represent specimens examined; open symbols represent literature reports.

W53-299, W53-409, W54-301, W54-302, W54-310, W55-326, W56-12, W56-129, W56-236, W56-330, W57-88, W58-64, W58-213, W58-223, W60-26, W60-132, W60-185, W60-194. SIO H49-75, H52-388, 52-430, 55-227, 55-243, 55-245, 55-247, 57-75, 58-150, 58-153, 58-368, 58-370, 58-375, 58-442, 62-168. BC 56-364. SU 46409. BLLJ uncataloged, Socorro Island, 2 August 1962, FB62-294; 13°29'N., 91°30'W., 2 October 1956; 01°06.2'N., 91°30.7'W.

SYNOPSIS

Balistes polylepis is the most abundant and wide-ranging triggerfish in inshore continental waters of the eastern Pacific. *Sufflamen verres* is probably the next most abundant eastern Pacific balistid, and is more ubiquitous, apparently equally successful as a continental or insular inhabitant. *Pseudobalistes naufragium* is a relatively rare species in tropical continental waters. *Melichthys niger* is primarily an inhabitant of oceanic islands, and may be locally abundant in that environment. *Canthidermis maculatus* is primarily a surface oceanic species that occasionally occurs in inshore waters; it is the most wide-ranging and probably the most abundant, though dispersed, triggerfish in the eastern Pacific. The distribution of *Xanthichthys mento* in the eastern Pacific is not entirely clear; it is often associated with the oceanic islands, and may have an antitropical distribution.

The relationships of the eastern Pacific Balistidae are predominantly with the central and western Pacific Balistidae. With one possible exception in this family, the geminate relationship of species pairs in the eastern Pacific and the western Atlantic, common in many other families of fishes (Jordan, 1908) is lacking. *Balistes polylepis*, obviously related to the Atlantic *B. capriscus*, is more closely related to specimens we have seen from Hawaii. Of the other five species, *Pseudobalistes naufragium* and *Sufflamen verres* are related to species from the central and western Pacific and Indian Oceans which have no representatives in the Atlantic; *Xanthichthys mento* extends across the Pacific and forms a complex with two other species of the Indian and Atlantic Oceans; and *Melichthys niger* and *Canthidermis maculatus* are world-wide or pantropic species. Two species that occur in the western Atlantic, *Balistes vetula* and *Canthidermis sufflamen*, have no counterparts in the eastern Pacific.

A similar zoogeographic arrangement between eastern Pacific and western Atlantic species exists for the filefish family Monacanthidae, according to data of Berry and Vogege (1961) and Randall (1964). There are four species of this family in the eastern Pacific and 10 species in the western Atlantic. *Alutera scripta* (Osbeck) and *Alutera monoceros* (Linnaeus) have world-wide distribution. *Cantherhines dumerili* (Holland) ranges from the eastern Pacific to the western Indian Ocean and is related to *Cantherhines macrocerus* (Holland) of the western Atlantic, but no representative of this species complex is known from the eastern Atlantic. *Cantherhines tiki* Randall, an eastern Pacific en-

demic, is related to *Cantherhines verecundus* Jordan from Hawaii and to *Cantherhines fronticinctus* (Günther) from the western Pacific to the Indian Ocean, but has no Atlantic representative. One species in the western and eastern Atlantic, *Cantherhines pullus* (Ranzani), is related to *Cantherhines pardalis* (Rüppell) from Indian Ocean to French Oceania and to *Cantherhines sandwichensis* (Quoy and Gaimard) from the Central Pacific, but no representative exists in the eastern Pacific. The remaining six species are endemic to the Atlantic Ocean, and although at least three are closely related to other Indo-Pacific species, none of these is represented in the eastern Pacific—*Alutera schoepfii* (Walbaum), *Alutera heudeletii* Hollard, *Monacanthus tuckeri* Bean, *Monacanthus ciliatus* (Mitchill), *Stephanolepis hispidus* (Linnaeus), and *Stephanolepis setifer* (Bennett). There are no geminate species relationships between the eastern Pacific and the western Atlantic in this family.

Four species of the two families have a world-wide or circumtropical distribution. Of the remaining species, six are eastern Pacific and 12 are western Atlantic. Four of these 18 exist as complexes of two species each with nearly world-wide distribution. In the eastern Pacific, three species are not represented by closely related forms in the western Atlantic, and nine western Atlantic species have no close relatives in the eastern Pacific. Only two species (*B. polylepis* and *B. capriscus*) may have a strict amphi-American relationship, but current uncertainties restrict this evaluation.

In the Balistidae and the Monacanthidae, phylogenetic affinities of eastern Pacific species are closer to the Indo-West-Pacific than to the western Atlantic, and the species composition of the eastern Pacific is relatively depauperate with respect to that of the western Atlantic.

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